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ABSTRACT

This report provides data on Federal R&D funding as reflected in the 1978 budget. The analysis includes historical background for the determination of trends and offers comparisons with a number of economic indicators outside the scope of the Federal Funds survey. An attempt is made to assess the future direction of specific areas of Federal R&D support. The data are distributed by character of work, performers, fields of science, and Federal R&D support by States. University-performed research by fields is also covered, and data are given on scientific and technical information. (Author/BB)

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federal funds for research, development, and other scientific activities

FISCAL YEARS 1976, 1977, and 1978

SURVEYS OF SCIENCE
RESOURCES SERIES
NATIONAL SCIENCE FOUNDATION

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VOLUME XXVI

notes

The data for 1976-78 shown in the appendix tables and the text tables were collected from the agencies in March and April 1977 and are based on agency budgets as incorporated in the President's budget message to Congress. The 1978 data reflect requests for fiscal year 1978 and thus do not reflect subsequent congressional appropriations or changes made by Executive apportionment. Fiscal year 1977 data represent obligations estimated in the second quarter of fiscal year 1977 and include both appropriated funds and funds carried over from prior years.

Table and chart details may not add to totals because of rounding.

Significant changes in 1978 program requests resulting from congressional actions already taken at the time this report was prepared are noted in the text.

acknowledgments

This report was prepared in the Division of Science Resources Studies under the general guidance of Charles E. Falk, Director, and William L. Stewart, Head, R&D Economic Studies Section. Benjamin L. Olsen, Study Director, Government Studies Group, provided direction. Eleanor Stoddard was responsible for organizing the report and writing portions of the text. Barbara Leach wrote other portions of the text and assisted in the analysis. Dorthy K. Ham prepared statistical materials and graphic illustrations.

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FOREWORD

The growth and nature of Federal R&D funding has been a subject of public interest for many years, but more recently the structure of this funding has received increasing attention because of its varied effects on the economy. Since Federal agencies fund more than one-half of the entire national R&D effort, their policies and programs produce significant impacts on institutions and influence the direction of scientific inquiry and technological change. But these impacts have arisen more often from the net interaction of a host of agency mission requirements than from a coordinated strategy.

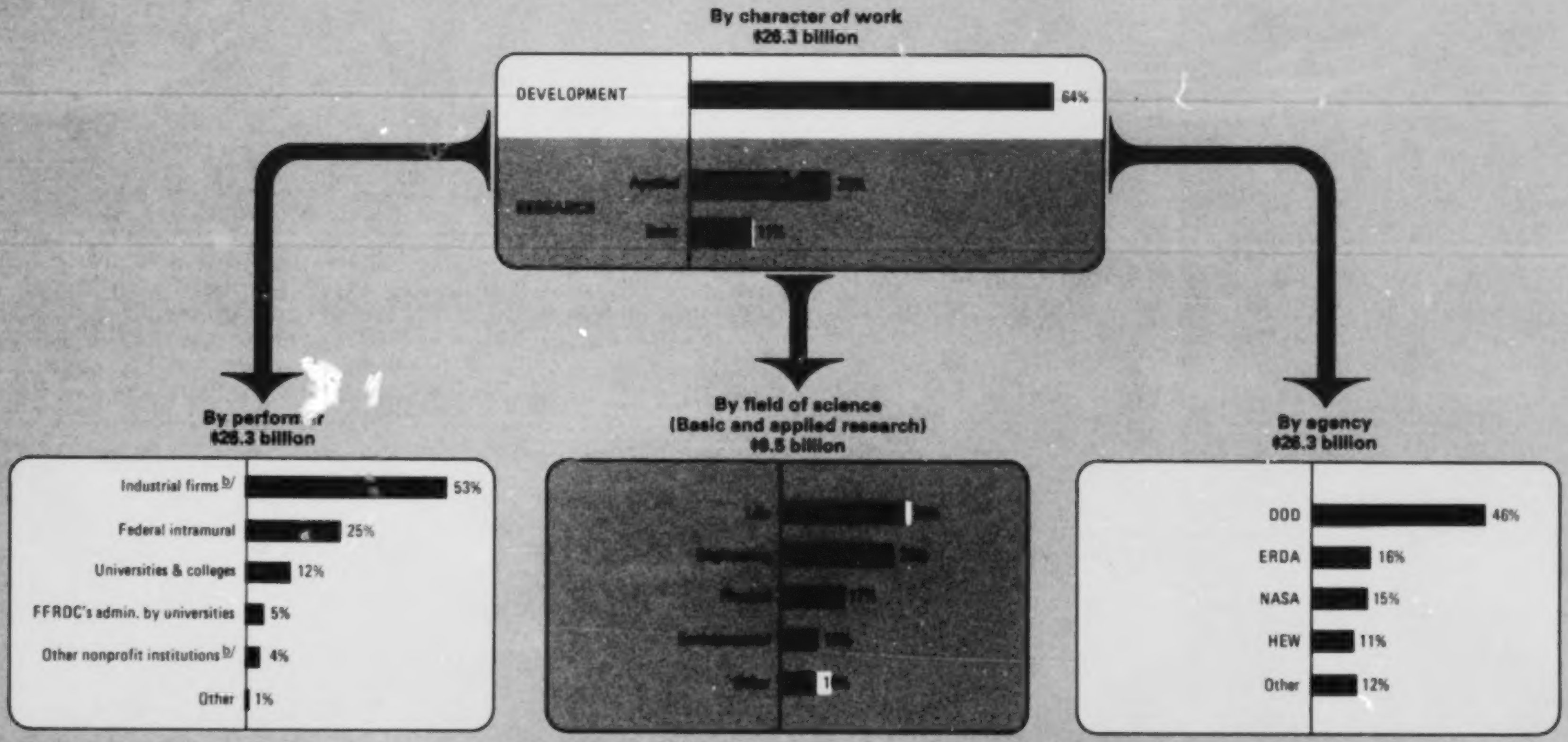
Since the 1977 budget, however, Federal support of basic research has reflected deliberate administration policy to fill a national need unmet by the private sector. In that budget and the next, basic research funds were increasd by Federal agencies to aggregate levels that would result in growth ahead of inflation. The effects of this policy on national R&D expenditures are already apparent in preliminary information that indicates an increased growth rate for national basic research in both 1977 and 1978 compared with reduced growth for applied research (and an uneven trend for development).

This report provides data on Federal R&D funding as reflected in the 1978 budget and is the 26th in an annual series based on the budget document. The analysis includes historical background for the determination of trends and offers comparisons with a number of economic indicators outside the scope of the *Federal Funds* survey. Because of the interest in Federal R&D activities as they affect the overall economy, an attempt is also made, where possible, to assess the future direction of specific areas of Federal R&D support.

Richard C. Atkinson
Director
National Science Foundation

December 1977

Distribution of Federal obligations for research and development: FY 1978(est.)[a]



[a]These data are based on the President's 1978 Budget to Congress; they exclude R&D plant data.

[b]Includes federally funded research and development centers (FFRDC's) administered by this sector.

SOURCE: National Science Foundation

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[1] See note on p. 47

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HIGHLIGHTS

Assessment Highlights

- In the next year or two the upward trend of Federal R&D funding is not expected to continue at the 3-percent average annual rate of the 1974-78 period (based on constant dollars) but is more likely to reflect growth close to the rate of inflation. The reason is that no new large-scale R&D program thrust is apparent in any area while a number of ongoing Federal development programs are subject to reappraisal, notably in defense and energy. The net result of recent reappraisals has been to slow the pace of development overall even though some individual programs have been increased.

- Congress approved most of the President's 1978 programs but cut back to some extent on defense R&D support while substantially increasing support for health and somewhat increasing support for energy. The net effect will probably be that health and energy reflect nearly equal shares of the Federal R&D total in 1978 after defense and space, which will remain in first and second position, respectively. Congress also added funds to the request for environment R&D programs, thus providing a measure of current-dollar growth for this area, and increased the emphasis already given by the President to food research.

- For Federal basic research support, growth ahead of inflation is expected to continue, at least for the near future, as a result of present administration policy that views adequate basic research support as essential to the continued growth of the economy and the ultimate solution of problems in many areas of national concern.

- Applied research however, is not expected to rise much faster than inflation in the next year or two, reflecting in large part the absence of new R&D programs likely to show significant growth.

- When viewed as a share of the total Federal budget, R&D and R&D plant outlays declined steadily from 9.5 percent in 1968 to 5.6 percent in 1976 but were expected to be 5.9 percent in 1978. The share fell primarily because of the rapid growth of social programs involving payments to individuals although declines in R&D funding also occurred in some years.

- When R&D and R&D plant outlays are compared with the relatively controllable portion of the budget, the ratio is seen to have declined far less—from 14.7 percent in 1968 to 13.4 percent in 1976, followed by a rise to an estimated 13.8 percent in 1978. These ratios indicate that research and development programs continue to play a significant part in agency missions.

- Present indications are that industry will continue to receive an increasing share of all Federal R&D funds in the next year or two, while universities and colleges receive only moderate increases even in constant-dollar terms. The Federal intramural sector is expected merely to keep pace with inflation. This projection is based on a continuation of trends from 1976 to 1978 during which time industry growth in real terms was three times that of the academic sector and intramural support scarcely grew at all. Recent industry growth has reflected expanding development programs in defense, space, and energy.

Data Highlights

- Federal R&D obligations were an estimated $26.5 billion in the President's 1978 budget to Congress, reflecting an average annual growth rate of 5.2 percent since 1968, or a decline of 1.0 percent in constant-dollar terms. During the last four years (1974-78), however, Federal funding has grown 10.9 percent on an average annual basis, or 3.0 percent after adjusting for inflation.

- Federal R&D support reflects a primary emphasis on defense programs, which made up almost one-half (49 percent) of all Federal R&D obligations in the President's 1978 budget. Space programs made up another 12 percent; energy programs, 11 percent; and health programs, 10 percent. These four areas have dominated Federal R&D support from 1975 to the present.[1]

- Although defense and space programs have shown significant increases in funding in recent years, a shift in Federal R&D support toward civilian-oriented programs and away from space/defense programs occurred in the 1968-78 decade. The "civilian" share grew from less than one-fourth to almost two-fifths in that period, but shares at the present time appear to be stabilizing.

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[1] The data on which these function comparisons are based are not shown in this report although they are taken from the same survey as the *Federal Funds* data. Function data, which are based on individual programs and cut across agency lines, are shown in *An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1978* (NSF 77-326) (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1978).

- Basic research was expected to total $3.0 billion in the 1978 budget and to amount to 11 percent of all Federal R&D obligations. Between 1974 and 1978 basic research obligations showed a 10-percent gain in constant dollars, partly as a result of administration policy. Between 1968 and 1978, however, a decline of 5 percent in real terms is still reflected.
- Applied research, at $6.5 billion in 1978, now accounts for one-fourth of the Federal R&D total. Between 1968 and 1978 a gain of 13 percent in real performance was recorded. Between 1977 and 1978, however, virtually no real growth was reflected.
- Development programs currently make up almost two-thirds of the Federal R&D total and were an estimated $16.8 billion in the 1978 budget. Since 1974 development funding has been growing more rapidly than research, chiefly as a result of DOD, ERDA, and NASA programs. Even so, federally funded development is an estimated 17 percent lower in 1978 than in 1968 in constant dollars.
- In 1978 an estimated $19.8 billion in Federal R&D obligations will be awarded to extramural performers—industry, universities, and nonprofit organizations. The remaining $6.5 billion, or 25 percent of the total, will be directed to intramural performance.

INTRODUCTION

From its inception the National Science Foundation has collected data on science resources in response to legislative mandates. The present report on Federal sponsorship of R&D programs is the 26th in an annual series and one among a number of recurring NSF reports on different aspects of national R&D activities. *Federal Funds for Research, Development, and Other Scientific Activities*, Volume XXVI represents a later and more detailed analysis of the R&D portion of the Federal budget than the one that appeared with the budget document.[1] The data in this report show R&D obligational levels as reported to the *Federal Funds* survey by 98 agencies in the March-May period of 1977, following the President's budget message in January. The data are distributed by character of work, performers, fields of science, and Federal R&D support by States. University-performed research by fields is also covered, and data are given on scientific and technical information.

All Federal agencies with R&D programs responded, and their data were based on budget request levels. Data were edited and processed by NSF staff, and appendix tables were prepared by computer processing and made available by the midyear.[2] A brief analysis of the contents of *Federal Funds*, Volume XXVI was also published as soon as survey totals were available.[3]

This report is focused on the three years of the 1978 Federal budget period, although comparisons with earlier years are noted. Data for fiscal year

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[1] See Office of Management and Budget, *Special Analyses, The Budget of the United States Government, Fiscal Year 1978*, "Special Analysis P: Research and Development Programs" (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office), 1977, p. 290.

[2] National Science Foundation, *Detailed Statistical Tables. Federal Funds for Research, Development, and Other Scientific Activities, Fiscal Years 1976, 1977, and 1978, Volume XXVI* (NSF 77-317), (Washington, D.C. 20550), 1977. These are obtainable gratis on request to NSF.

[3] National Science Foundation, *Science Resources Studies Highlights*, "Federal R&D Funding Shows Strong Recent Rise But Little Real Growth in 1978" (NSF 77-323) (Washington, D.C. 20550), October 17, 1977.

1976 are actual, but data for the next two years are tentative. Fiscal year 1977 data reflect obligations estimated in the second quarter of fiscal year 1977; agencies based these estimates on funds appropriated plus obligations carried over from prior years and on agency program plans at the time. The 1978 data are based on amounts requested in the President's budget for fiscal year 1978, including estimates for carryovers, but do not reflect subsequent congressional appropriations or changes made by Executive apportionment. The text makes note of significant changes in 1978 program levels resulting from congressional actions taken at the time this report was prepared in order that information may be as up-to-date as possible.

Data for the transition period, July 1 - September 30, 1976, that permitted a shift to the new October 1 - September 30, 1976 budget year, have been collected in broad totals only for basic research, applied research, and development but not for more detailed categories. These data have not been published but are available on request.

While the statistics in this report do not reflect the precision used for accounting purposes, they are comparable from one year to the next and provide an accurate measure of trends. Borderline problems exist in that some R&D programs are not clearly defined as such. Most agency R&D programs have to be separated by respondents from other larger programs because they are not identified as budget line items, and in certain cases questions arise as to appropriate classificaion. R&D programs, once identified, must then be further subdivided into the survey categories: basic research, applied research, development, performers, fields, etc. Since agency records are often kept by categories other than those requested in the survey, judgment in reporting data must be used by the respondents. Over the years, however, agencies have gained considerable experience in meeting the data requirements.

Agencies are users as well as producers of these data. Other users besides agencies include congressional staff, Federal science administrators, performers in the private sector, science historians, science policy analysts, and the science press. The data serve as a baseline for determining trends and also as a starting point for more intensive studies.

Part I

FEDERAL FUNDS FOR RESEARCH, DEVELOPMENT, AND R&D PLANT

Section 1. FEDERAL R&D PERSPECTIVES

Although Federal R&D obligations (plant excluded) rose from $15.9 billion in fiscal year 1968 to an estimated $26.3 billion in the President's 1978 budget request to the Congress, most of the growth has taken place in the last four years. From 1968 to 1974 the average annual growth rate was 1.5 percent, or a decline of 3.7 percent in constant dollars,[1] whereas from 1974 to 1978 the average annual growth rate is 10.9 percent, or an increase of 3.0 percent in constant-dollar terms.

The last three years have witnessed Federal R&D growth that was ahead of inflation each year (and 1975 reflected unusually steep growth as well, almost sufficient to match the record inflation of that year). At present, however, the outlook appears to indicate growth no greater than the rate of inflation, or only slightly higher. All Federal programs are now viewed more critically in the light of alternative options, and R&D programs, including some that may be in fairly advanced stages of development, are not excepted from this kind of assessment. No new large-scale R&D program initiatives have been introduced, and thus the Federal R&D total will largely reflect a continuation of present undertakings. The next year or so will appear more like the early seventies than the early sixties when high yearly increases were in order.

Growth between 1974 and 1978 has been engendered more by development than by research. Real growth for Federal development programs between 1974 and 1978 was 15 percent (compared with a constant-dollar decline of 28 percent between 1968 and 1974). Since development now accounts for almost two-thirds of the Federal R&D total, the rise or fall of this component has the most effect on overall levels. While it can be assumed that most large development programs now in progress will be brought to culmination and new ones brought to the full development stage, some programs may be significantly reduced. This has already occurred in the energy and defense areas, as in the case of the Clinch River breeder reactor and the B-1 bomber. Large development programs are now likely to be questioned at each stage as to their effect on broader strategies. Such an approach acts as a brake on strong overall Federal R&D growth.

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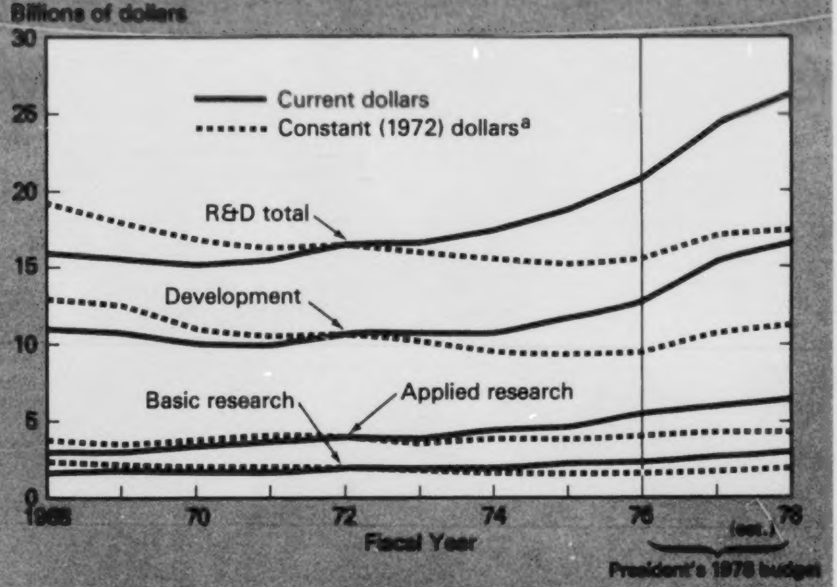
[1] In the absence of a reliable R&D cost index the GNP implicit price deflator has been used for the years 1968-77 and an estimate of inflation made for 1978.

Federal R&D obligations by character of work: FY 1968-78

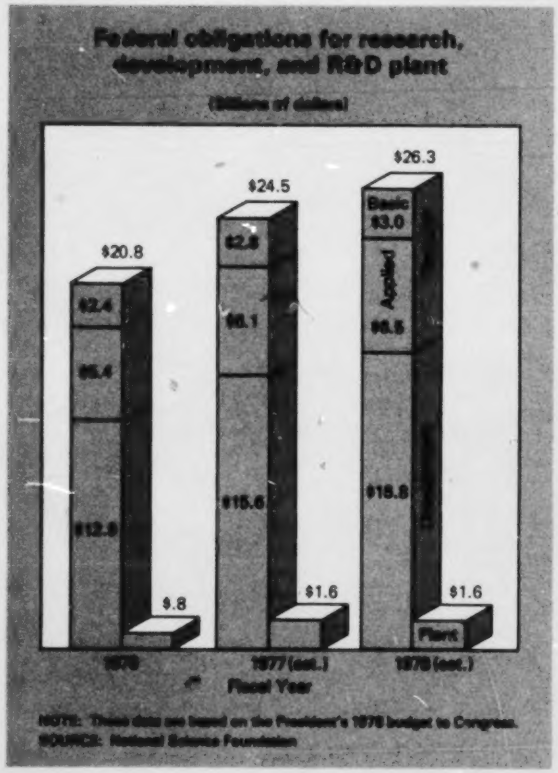


Average Annual Percent Change

Character of work	1968-74	1974-76	1976-77	1977-78
Current dollars				
R&D total	1.5	9.2	17.9	7.6
Research	5.0	10.0	12.4	7.2
Basic research	2.9	9.0	13.6	9.3
Applied research	6.1	10.4	11.9	6.2
Development	– .2	8.7	21.2	7.8
Constant dollars[a]				
R&D total	–3.7	.5	10.6	1.3
Research	– .4	.9	5.6	.9
Basic research	–2.3	.2	6.6	3.0
Applied research	.7	2.7	5.1	(b)
Development	–5.3	– .2	13.7	1.5

[a] Based on GNP implicit price deflator with an estimate for 1978.
[b] Less than .05 percent.
SOURCE: National Science Foundation

Basic research, in comparison, has received special emphasis as a total area in the last two Federal budgets. The higher totals have produced a constant-dollar growth of 10 percent between 1974 and 1978 in comparison with constant-dollar growth of 8 percent for applied research. This policy has changed the direction of earlier (1968-74) trends where basic research declined in real terms and applied research grew. But even if basic research continues to be supported in the near future at levels that produce real growth, the effect on overall Federal R&D obligations will be slight since basic research is currently 11 percent of the Federal R&D total.



Federal obligations for research, development, and R&D plant

(Billions of dollars)

NOTE: These data are based on the President's 1978 budget to Congress.
SOURCE: National Science Foundation

Federal overall and R&D obligations and outlays: FY 1940-78

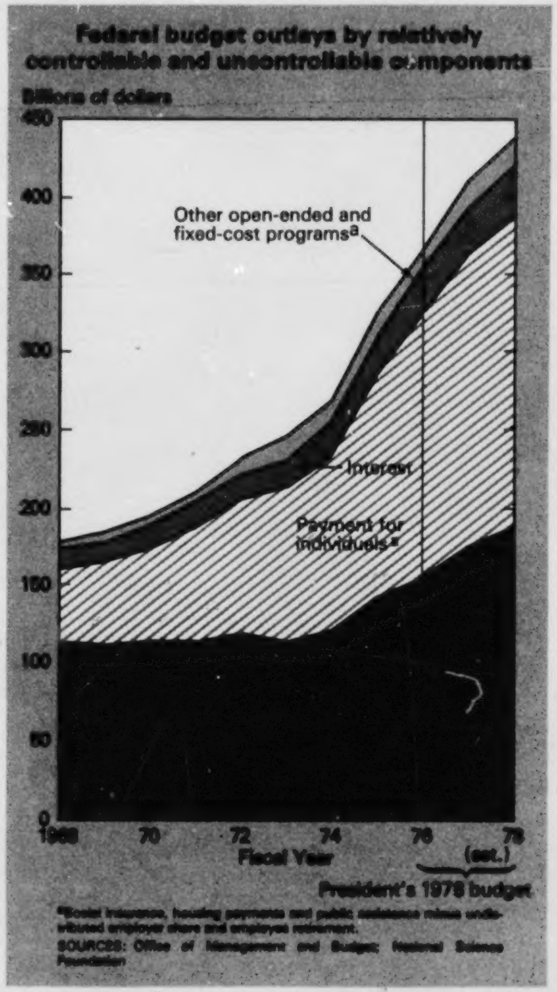
[Dollars in millions]

Fiscal year	Total budget outlays[1]	Research, development, and R&D plant[2]		R&D-related outlays as percent of total budget outlays
		Obligations	Outlays	
1940	$ 9,589	(3)	$ 74	0.8
1941	13,980	(3)	198	1.4
1942	34,500	(3)	280	.8
1943	78,909	(3)	602	.8
1944	93,956	(3)	1,377	1.5
1945	95,184	(3)	1,591	1.7
1946	61,738	(3)	918	1.5
1947	36,931	$ 691	900	2.4
1948	36,493	868	855	2.3
1949	40,570	1,105	1,082	2.7
1950	43,147	1,175	1,083	2.5
1951	45,797	1,812	1,301	2.8
1952	67,962	2,195	1,816	2.7
1953	76,769	3,361	3,101	4.0
1954	70,890	3,039	3,148	4.4
1955	68,509	2,745	3,308	4.8
1956	70,460	3,267	3,446	4.9
1957	76,741	4,389	4,462	5.8
1958	82,575	4,906	4,991	6.0
1959	92,104	7,123	5,806	6.3
1960	92,223	8,080	7,744	8.4
1961	97,795	9,607	9,287	9.5
1962	106,813	11,069	10,387	9.7
1963	111,311	13,663	12,012	10.8
1964	118,584	15,324	14,707	12.4
1965	118,430	15,746	14,889	12.6
1966	134,652	16,179	16,018	11.9
1967	158,254	17,149	16,859	10.7
1968	178,833	16,525	17,049	9.5
1969	184,548	16,310	16,348	8.9
1970	196,588	15,865	15,736	8.0
1971	211,425	16,150	15,992	7.6
1972	232,021	17,100	16,743	7.2
1973	247,074	17,574	17,510	7.1
1974	269,620	18,181	18,326	6.8
1975	326,105	19,834	19,590	6.0
1976	366,466	21,595	20,688	5.6
1977 (est.)[4]	411,243	26,069	23,244	5.7
1978 (est.)[4]	439,967	27,883	25,851	5.9

[1] Beginning in fiscal year 1953 amounts for both obligations and outlays include pay and allowance of military personnel in research and development. [2] "Outlays" include expenditures plus net lending. Data through fiscal year 1953 are in terms of the "Consolidated Cash Statement" and data beginning with fiscal year 1954 are in terms of the "Unified Budget." [3] Not available. [4] These estimates are based on amounts shown in *The Budget, 1978.* SOURCES: Office of Management and Budget and Bureau of the Budget, *The Budget of the United States Government,* fiscal years 1940 through 1978; National Science Foundation annual surveys of R&D programs of Federal agencies.

Share of Budget

Until 1965 the share of R&D and R&D plant outlays in the total Federal budget had been rising steadily for 13 years, but thereafter a decline set in. Between 1968 and 1976 the share dropped steadily from 9.5 percent to an estimated 5.6 percent. The share in 1977 was an estimated 5.7 percent, and in 1978 the share will rise to an estimated 5.9 percent.

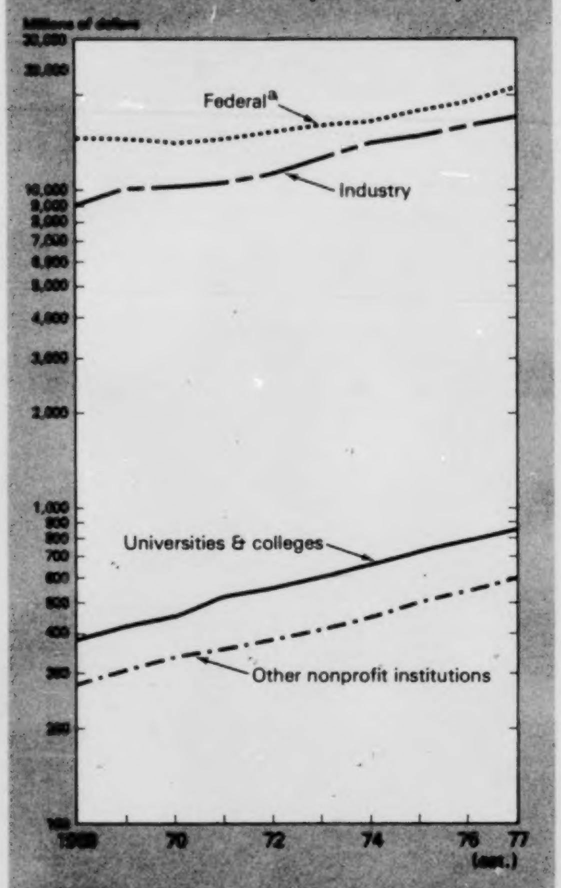


Federal budget outlays by relatively controllable and uncontrollable components

[a] Social insurance, housing payments and public assistance minus undistributed employer share and employee retirement.
SOURCES: Office of Management and Budget; National Science Foundation

Another and more sensitive indicator of Federal R&D policies can be found in changes in the ratio of R&D programs to the relatively controllable portion of the budget. The controllable portion, of which R&D programs are a part, is subject only to annual authorization and appropriation actions as distinct from the uncontrollable area where the growth of fixed cost and open-ended programs[2] cannot be regulated except by changes in existing substantive law. R&D and R&D plant outlays as a share of controllable budget outlays have fluctuated fairly narrowly in the 1968-78 period—moving from 14.7 percent to an estimated 13.8 percent—a sign that the role of research and development in the fulfillment of mission responsibilities has not changed significantly.

Trends in national R&D expenditures by source



[a] R&D plant expenditures are excluded from these data.

NOTE: Data shown in this chart are based on reports by performing sectors rather than by Federal agencies, the reverse of reporting for Federal Funds. Totals are therefore somewhat lower than those shown in Federal Funds surveys, but trends are the same.

SOURCE: National Science Foundation

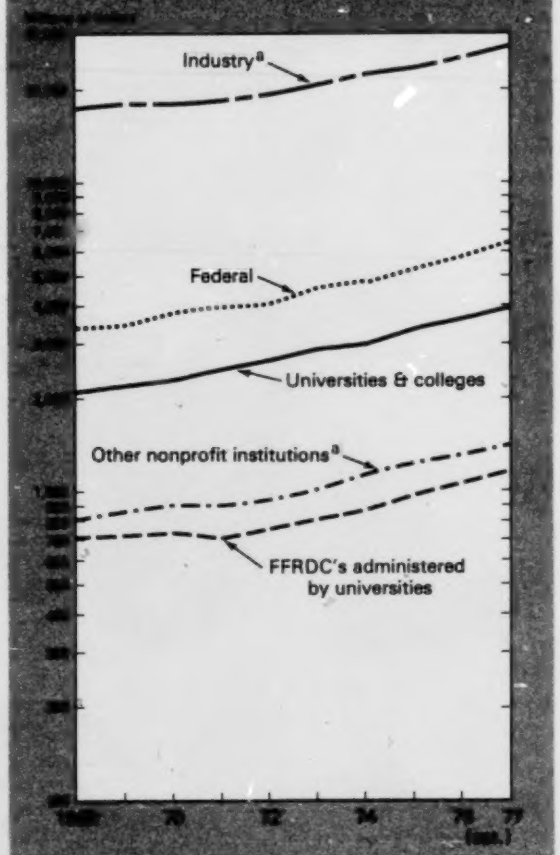
Relationship to the National R&D Total

Between 1968 and 1977 total national R&D expenditures grew from $24.6 billion to an estimated $40.8 billion, but during this period, Federal support fell from 61 percent of all national expenditures to an estimated 53 percent and stabilized at that share during the last three years. Until 1971 Federal funding fluctuated slightly from year to year, but annual growth was shown thereafter, especially from 1975 onward. The industrial, university-and-college and other nonprofit sectors all increased R&D support in each year of the 1968-77 period, and the industry share of the total increased from 37 percent to an estimated 43 percent.

The pattern of R&D *performance*, however, showed less change in the same timespan. The chief differences are that industry now carries out slightly less of the total national R&D effort—69 percent in 1977 compared with 71 percent in 1968—and Federal agencies and universities and colleges, slightly more. The Federal share of performance has grown from 14 percent to 16 percent and the academic share, from 9 percent to 10 percent.

The facts behind these shifts in source/performance ratios are that industrial firms, until recently, have received less support for research and development from Federal agencies (mostly notably the Department of Defense (DOD) and the National Aeronautics and Space Administration (NASA)) but have provided increasing funds for R&D performance on their own account, virtually all of which can be

Trends in national R&D expenditures by performer



[a] Includes federally funded research and development centers (FFRDC's) administered by this sector.

SOURCE: National Science Foundation

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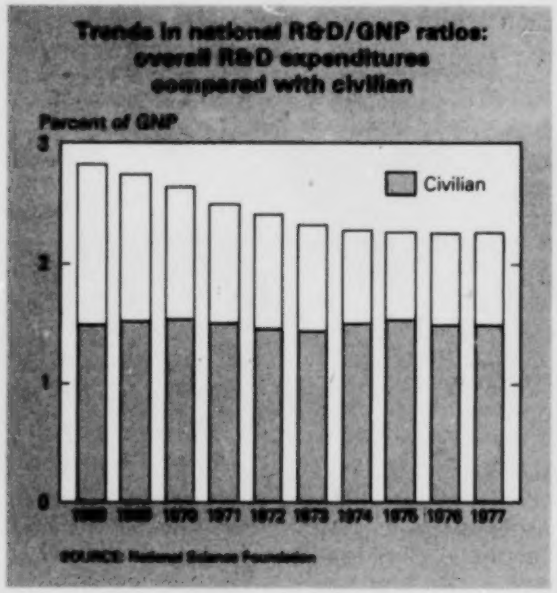
[2] Social security, medical insurance, veterans benefits, public assistance, interest, and miscellaneous other programs. See Office of Management and Budget, *The Budget of the United States Government, Fiscal Year 1978*, table 16 (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office), pp. 420-21.

considered as supporting "civilian" undertakings. Universities and colleges have received increased funding from Federal agencies (their chief source of support), and most of this has been directed to basic research and applied research in societal areas. Thus, an increase in the share of the national R&D effort devoted to civilian programs versus those devoted to defense/space areas has taken place—from 52 percent in 1968 to an estimated 68 percent in 1977. These shares are approximate, and the likelihood is that the present (approximate) share will not change very markedly in the near term since the increased rate of industry spending will probably be offset by the increased rate of Federal spending for defense/space programs.

Relationship to GNP

Even though the share of national R&D expenditures within the gross national product (GNP) has been decreasing—from 2.8 percent in 1968 to an estimated 2.3 percent in 1977, more and more work within that share has been devoted to improving the standard of living and meeting social problems. Broadly speaking, civilian-oriented R&D activities sponsored by all sources, public and private, slightly more than doubled from 1968 to 1977, while total national R&D efforts grew by two-thirds. The ratio of civilian R&D expenditures to GNP was 1.5 percent for most years of the 1968-77 period. Such a ratio does not compare unfavorably with the R&D/GNP ratios of other major industrialized countries when their R&D expenditures for defense and space have been eliminated. The 1.5-percent "civilian" ratio of the United States is higher than comparable ratios for France and Canada in 1975 and very close to that of the United Kingdom, although somewhat lower than that estimated for Japan. The one country with a "civilian" R&D ratio as high as 2 percent was West Germany.[3]

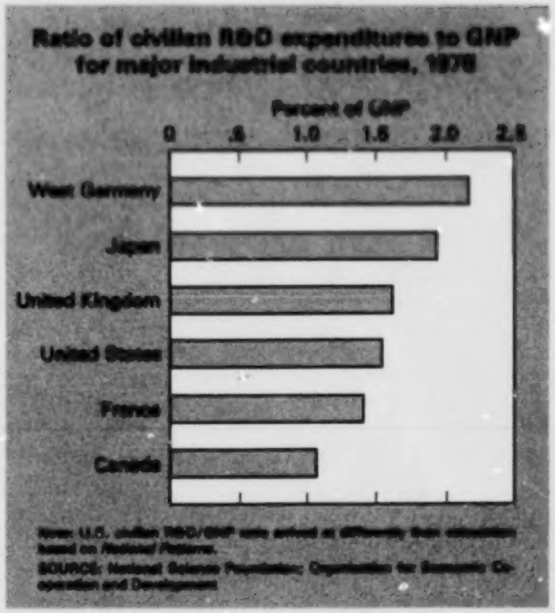

Trends in national R&D/GNP ratios: overall R&D expenditures compared with civilian

SOURCE: National Science Foundation

Ratios of R&D expenditures to GNP are only one indication of the relationship of R&D investment to the national economy. An equally important consideration involves the factors and incentives that lead from the R&D phase to innovation, and this question is likely to receive increasing attention in the years just ahead.

Historical Perspective

The growth trend of 1974-78 follows a 7-year period (1968-74) when only slight changes were recorded from one year to the next in Federal R&D funding with the exception of 1972 when a 6-percent increase occurred that was almost wholly attributable to one agency—DOD. In the entire period the only agencies among those supporting R&D programs above the $50 million level that recorded steady upward growth were the Department of Agriculture (USDA) and the Veterans Administration (VA). These were years marked by a steady decline in funding of NASA as the Apollo mission was phased out, and virtually no growth in DOD funding. In 1974 the R&D total for DOD was only $711 million higher than in 1968 (and $371 million higher than in 1967). DOD and NASA continued to be the two leading agencies in R&D support, however. Between 1968 and 1974 Federal R&D funding moved up only 9 percent in current dollars (while decreasing 20 percent in constant dollars).


Ratio of civilian R&D expenditures to GNP for major industrial countries, 1975

Note: U.S. civilian R&D/GNP ratio arrived at differently than estimations based on National Patterns.
SOURCE: National Science Foundation; Organization for Economic Co-operation and Development

But after 1974 a fundamental change took place. In the previous seven years the well established character of most R&D programs had resulted in Federal R&D totals that changed relatively little from one year to the next, sometimes declining slightly. No strong program expansion from any area was reflected in overall R&D levels. By 1974, however, Federal R&D obligations began to rise as the result of a number of major policy initiatives that had already been set in motion.

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[3] Data are derived from the National Science Foundation, Division of Science Resources Studies and the Organization for Economic Co-operation and Development.

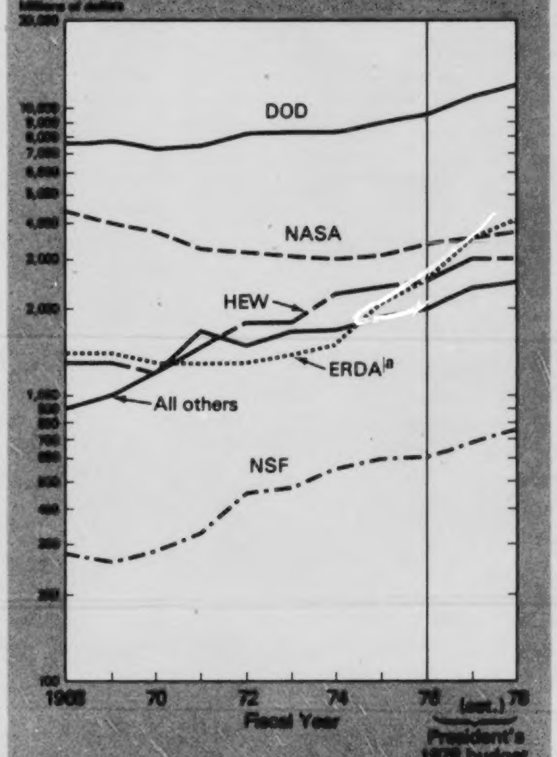
Policy Initiatives

In the 1972 budget administration policy was focused on higher overall *defense* spending, following a 3-year period of no growth. This decision was subsequently reflected in DOD totals, especially in 1974 and later years, as succeeding administrations added impetus to this policy. The effect on R&D programs was somewhat more delayed; after significant growth in 1972, R&D support to DOD did not rise again until 1975, but since then yearly growth has been significant.

Energy shortages, brought home by the Arab oil embargo in the fall of 1973, heightened public awareness of the need for a manifold expansion in the energy research and development that was already in process. Energy R&D funding, provided mostly by the Energy Research and Development Administration (ERDA), has tripled since 1974, reflecting both Presidential and congressional support. In the past decade growth in energy research has also shifted in terms of the share of the ERDA budget devoted to atomic defense programs: from 44 percent in 1968 to an estimated 20 percent in 1978.

Health was given special emphasis in the 1972 budget message with a Presidential announcement of a $100 million increase in funds targeted on cancer research under the sponsorship of the Department of Health, Education, and Welfare (HEW), and support to cancer research was carried further through 1974 when an additional emphasis was also placed on heart and lung research. In subsequent years the rates of growth diminished, and in the 1977 and 1978 budgets growth for other biomedical research areas has outpaced cancer, and heart and lung research, a pattern that remained even after congressional action on 1978 HEW programs. Even so, cancer and heart and lung research still account for one-half of the R&D obligations of the National Institutes of Health (HEW).

Trends in R&D obligations of Federal agencies leading in R&D programs



[a] Prior to 1974 AEC data were used.

SOURCE: National Science Foundation

As the Apollo program phased down in the early seventies, a new broad policy evolved for *space*. The 1972 budget stressed a balanced program guided by three purposes: space exploration, scientific investigations, and practical applications. This budget included funds to start development of the space shuttle engine. It was not until 1975, however, that large increases in space shuttle funding produced an upward trend in total R&D levels for NASA. Skylab, which peaked in 1972, had been terminated by 1975. The share of the NASA budget devoted to purely space activities—manned space flight, space sciences, space technology, and tracking and data acquisition—has declined from 95 percent in 1968 to an estimated 81 percent in 1978. NASA programs in space applications and aeronautical research and technology have accounted for the remainder, a share that has been increasing to the present 19 percent.

After 1974 the Federal R&D total began to move significantly higher, increasing by 9.2 percent in both 1975 and 1976. All major agencies shared in this growth. Even NASA funding increased as development support for the space shuttle grew by larger increments. The chief influences on growth, however, were DOD and ERDA.

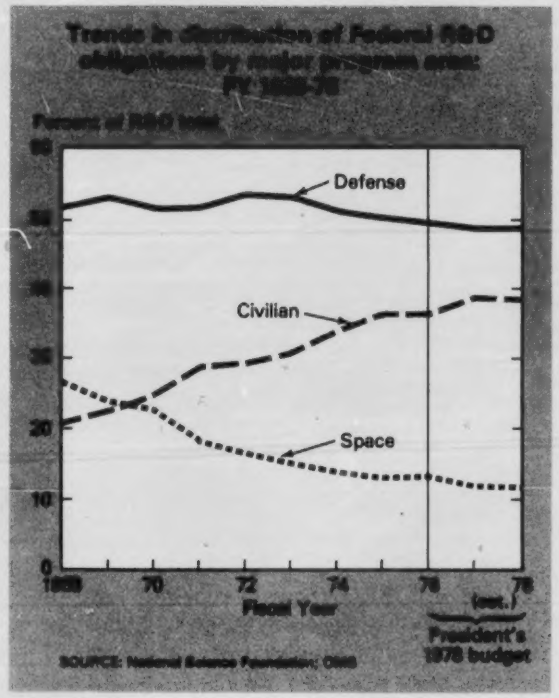
In 1977 the Federal R&D growth was an estimated 17.9 percent, bringing the Federal R&D total to $24.5 billion, with increases shown by virtually all agencies. Even though more than one-fourth of the rise can be attributed to estimated carryovers, increases in budget authority were substantial. The President's budget proposal for fiscal year 1978 called for a further overall R&D increase to $26.3 billion, or 7.6 percent. Despite the strong gains of recent years, estimated real performance in 1978 in constant dollars is still 10 percent below that of 1968.

Functional Patterns

The outstanding feature of Federal R&D support in the 1968-78 decade has been the sharp rise in emphasis on "civilian" R&D programs in contrast to those in defense and space. Growth and change are evident in the agencies that sponsor programs in these different areas. In 1968 DOD and NASA sponsored three-fourths of all Federal R&D activities; by 1978, however, their share was an estimated three-fifths. Even though DOD and NASA obligational totals have been rising significantly since 1974, the strong gains for ERDA, HEW, and the National Science Foundation (NSF) have prevented the DOD/NASA share of the Federal R&D total from increasing.

Federal R&D programs can be categorized by their own primary purposes, rather than by supporting agencies, and arranged by selected functions that cut across agency lines. On this basis defense programs are found to represent 49 percent of the Federal R&D total in 1978; space programs, 12 percent; energy programs, 11 percent; and health programs, 10 percent. These four areas have been the leading ones in Federal R&D support since 1975.[4]

In 1969 (the first year detailed functional data were compiled) defense programs made up 53 percent of the Federal R&D total and space programs, 24 percent. The third most important area was health with 7 percent of the total, and the next was science and technology base with 3 percent. Areas like energy and environment were to achieve their most significant growth in later years.


Trends in distribution of Federal R&D obligations by major program area: FY 1968-78

SOURCE: National Science Foundation; OMB

Character of Work

As DOD and NASA programs declined in emphasis between 1968 and 1976, development fell steadily as a share of the R&D total: from 69 percent to 62 percent. But a reversal has occurred in that the share is an estimated 64 percent in both 1977 and 1978. This increase reflects recent DOD and NASA growth and the expanded energy programs of ERDA.

Basic research funding stayed at about the same level from 1968 to 1971 and thereafter has risen steadily until 1978. The proposed increase from 1977 to 1978 was 9 percent, reflecting a Presidential policy decision to support basic research growth by 3 percent in constant dollars. The share of basic research within the Federal R&D total was 11 percent in 1968, then rose to 12 percent from 1972 through 1976; the estimated shares for the most recent two years are 11 percent in each year. Chief support agencies have been HEW, NSF, ERDA, NASA, and DOD. In the 1978 budget HEW provided more than one-fourth of the support and NSF more than one-fifth.

The applied research share of the Federal R&D total has grown relative to basic research and development in the 1968-78 decade—from 20 percent to 25 percent. The reason is twofold: not only has applied research funding increased substantially but basic research funding and development funding have also grown less rapidly (development support did not regain the 1968 level until 1975). Applied research growth has been mainly sustained by HEW and DOD programs over the long term with much of this growth related to increased support to biomedical research and increased efforts in military technology base programs. More recently expansion of applied research in fusion power, in environmental effects of energy, and in atomic weaponry has been shown in increased ERDA support levels while greater applied efforts within the aeronautical research and technology program have been reflected in overall NASA support to this area.

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[4] See National Science Foundation, *An Analysis of Federal R&D Funding by Function, Fiscal Years 1969-1978* (NSF 77-326) for an analysis of programs by objective that cuts across agency lines, op. cit.

Between 1968 and 1978 Federal support to basic research has declined 5 percent in constant dollars, and development has declined 17 percent. Applied research has increased 13 percent in constant-dollar terms.

Performers

The pattern of performer use by Federal agencies has changed somewhat between 1968 and 1978. In 1968 only 22 percent of Federal R&D work ws intramurally performed. This share rose steadily until 1975 when it reached 28 percent. Since then, the intramural share has been declining and will be an estimated 25 percent in 1978. One cause of the declining intramural share has been a DOD policy to involve extramural performers more heavily in the technology base area where DOD laboratories had been concentrating their work. Real intramural performance (in constant dollars) has grown an estimated 2 percent between 1968 and 1978. Chief intramural support agencies have been DOD and NASA, which have accounted for shares of 49 percent to 56 percent and 19 percent to 23 percent of the total, respectively, followed by HEW, USDA, and the Department of the Interior.

A somewhat similar trend appeared in the university area. In 1968 universities and colleges performed 9 percent of all Federal R&D undertakings, and by 1974 they performed 13 percent. The change reflected the increased emphasis on research as contrasted with development programs within the Federal R&D total. The share had fallen to 12 percent by 1976 but has since remained the same. With increased development programs it might have fallen further except for the added Federal support to basic research. HEW, NSF, DOD, and NASA have been leading agency users of the academic sector in the past decade with ERDA more important than NASA in recent years. Significantly, the growth in real performance for universities and colleges is an estimated 13 percent between 1968 and 1978.

The chief reason for the shifts in intramural and university shares lies in the decreasing relative use of industry (and associated FFRDC's) for development programs from 1968 to 1975 and the increasing use since then. Actual Federal support to industrial firms fell until 1971 and rose very little until 1975, but since then has grown importantly. The industry share of the Federal R&D total was 59 percent in 1968, fell to 48 percent in 1975, and is an estimated 53 percent in 1978. Chief agency users of industrial firms (and industry FFRDC's) have always been DOD, NASA, and ERDA, and as their programs have grown more rapidly in recent years, industrial performance has risen.

Between 1968 and 1978 real performance by this sector has dropped 19 percent. The future use of industry for Federal R&D undertakings will presumably show a continued increase in the near term, but some energy programs may shift to non-R&D emphases a few years hence, and funding for the space shuttle, now the largest Federal R&D program, will tend to decline as development is completed. Thus, later upward growth may depend on other eventualities.

Section 2. PROGRAMS AND PERFORMERS

- In 1977 the 10 leading agencies in R&D support accounted for an estimated 98 percent of the Federal R&D total, and in the President's budget request for 1978 the same situation prevailed. Compared with a decade earlier, however, the present distribution of agency R&D participation is significantly more widespread. In 1968 four leading agencies accounted for 93 percent of all Federal R&D obligations; in the 1978 budget six leading agencies—DOD, ERDA, NASA, HEW, NSF and USDA—accounted for that same percentage.

Current Programs

- In 1977 the R&D activities of DOD represented an estimated 16-percent increase over the previous year, and the President's budget request for 1978 contained an 8-percent increase over 1977, with each of the armed services showing growth. The 1978 DOD total was $12.1 billion. Congress later reduced the RDT&E level[5] by approximately 2.5 percent, with the resulting effect on the different services and on individual programs not exactly calculable.

  Although R&D obligations for DOD have shown steady growth since 1970, the share of DOD within all Federal R&D activities has tended to decrease somewhat. From a high point for the past decade of 50 percent in 1972 and 1973, it has gradually declined to 46 percent in the 1978 budget.

  The Air Force, which has accounted for the largest share of DOD R&D programs in the past 10 years (an estimated 36 percent in 1978) is responsible for the largest strategic DOD program—the B-1 bomber. This project reflected a lower level of funding in 1978 than in 1977 since development was nearing completion. Although Presidential action was taken subsequent to the budget request to cancel funds for procurement of the B-1 aircraft, R&D support was to continue. Other important strategic Air Force activities included the M-X intercontinental ballistic missile, with an increase requested for continued full-scale development, and the AGM-86, ALCM air-launched cruise missile, also with a significant increase requested. The advanced ballistic re-entry system, another large strategic program, reflected a moderate decrease. Large tactical programs included the F-16 combat fighter, currently requiring lower funding as development enters later stages, and the E-3A advanced warning and control system (AWACS), with a small increase requested. The Air Force is also responsible for the development of the interim stage (IUS) of the space shuttle; a sizable increase requested for this program was largely granted by the Congress.

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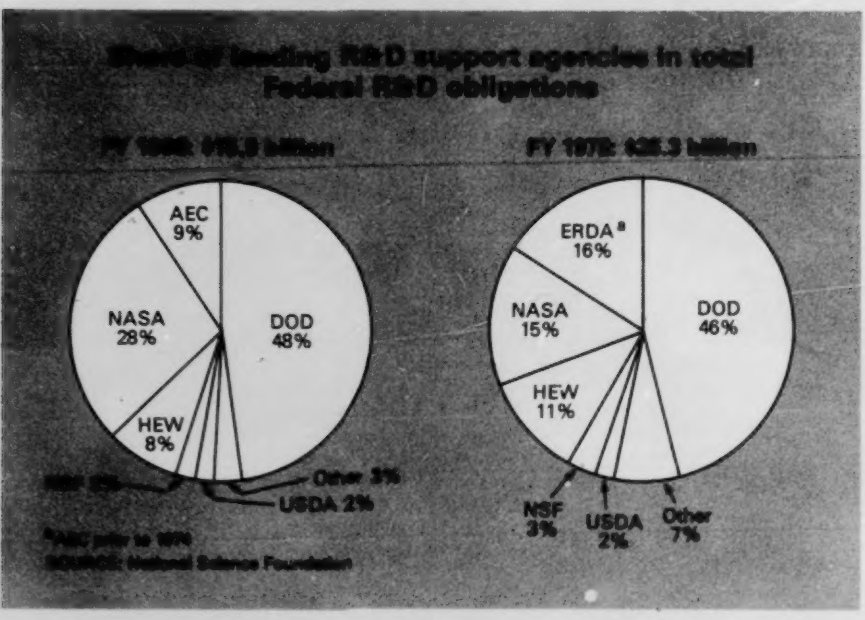
[5] The research, development, test and evaluation (RDT&E) appropriation makes up all DOD R&D activties except for relatively small amounts used for R&D plant and minor amounts from other DOD appropriations primarily for personnel engaged in R&D activities. The largest RDT&E area is that of tactical programs, which in 1977 and 1978 represents more than one-third of the total. Next are strategic programs, which make up about one-fifth. Other activities are categorized under technology base, intelligence and communications, advanced technology development, and programwide management and support.



Share of leading R&D support agencies in total Federal R&D obligations

[a] AEC prior to 1975

SOURCE: National Science Foundation

Support for Navy R&D programs in the 1978 budget request amounted to 35 percent of the DOD total. Naval R&D activities have always been second in size of funding to those of the Air Force, but currently the amounts are close. The Navy is now sponsoring the largest single DOD project—the F-18 combat fighter for tactical use. The requested increase for 1978, the largest of any R&D program, was unchanged by the Congress. Two other large ongoing tactical Navy programs cover LAMPS helicopter and V/STOL aircraft development, both programs scheduled for increases.[6] On the strategic side, the largest Navy program is the Trident I submarine-launched missile system, with considerably lower funding needed in 1978 as development enters later stages. The Tomahawk submarine, surface, and air-launched missile is another large strategic program, which reflected a substantial requested increase in 1978.

Army R&D programs represented 22 percent of the DOD total in the President's budget. The two largest single Army programs—the SAM-D Patriot surface-to-air missile system and the XM-1 tank—are both in the tactical area. Both are scheduled for increases in 1978. The third-largest tactical program is the AAH advanced attack helicopter, for which reduced funding was requested in the President's budget but which subsequently received increased funding for 1978 through congressional action. The two chief strategic Army programs are the ballistic missile defense systems technology program, and the ballistic missile defense advanced technology program, both showing a steady level of effort.

- ERDA is the agency with the most rapidly growing R&D programs.[7] These have more than doubled since 1975. In 1977 estimated R&D obligations for this agency were $3.6 billion, and the total requested by the President for 1978 was $4.1 billion, placing ERDA second after DOD in R&D support. As a share of all Federal R&D obligations ERDA programs have increased from 9 percent in 1968 to an estimated 16 percent in 1978.

Federal obligations for research and development by agency

[Dollars in millions]

Agency	Actual			Estimates			
	1968	1976	Average annual percent change 1968-76	1977	Percent change 1976-77	1978	Percent change 1977-78
Total	$15,921	$20,759	+3.4	$24,465	+17.9	$26,317	+7.6
Department of Defense	7,709	9,655	+3.3	11,172	+15.7	12,108	+8.4
Energy Research and Development Administration[1]	1,369	2,499	+7.8	3,610	+44.5	4,143	+14.8
National Aeronautics and Space Administration	4,429	3,447	-3.1	3,610	+4.7	3,848	+6.6
Department of Health, Education, and Welfare	1,252	2,546	+9.3	2,960	+16.2	3,009	+1.7
National Science Foundation	283	609	+10.1	686	+12.6	758	+10.4
Department of Agriculture	254	462	+7.8	525	+13.6	574	+9.2
Deparment of Transportation	172	295	+7.0	407	+38.3	398	-2.2
Department of the Interior	191	314	+6.4	348	+10.9	362	+3.8
Environmental Protection Agency	—	259	—	361	+39.5	311	-14.1
Department of Commerce	84	229	+13.4	247	+8.1	240	-3.2
Nuclear Regulatory Commission	—	88	—	114	+28.8	139	+22.1
Other agencies	179	356	+9.0	424	+19.4	428	+.9

[1] Atomic Energy Commission prior to 1974.

SOURCE: National Science Foundation

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[6] The term "scheduled" refers to congressional action.

[7] On October 1, 1977 the functions of ERDA were transferred to the newly established Department of Energy (DOE). The amounts shown in this report, however, were all reported by ERDA and reflect ERDA plans and estimates.

The principal mission of ERDA has been to develop and foster economical and effective energy sources and uses, and 80 percent of the ERDA budget for research and development in 1978 was devoted to energy and energy-related programs. The remaining 20 percent was devoted to weapons R&D and naval reactor development.

Direct nuclear energy programs made up 34 percent of the R&D total of ERDA, as shown in the President's budget request. Among these the liquid metal fast breeder reactor (LMFBR) showed a decline in obligations in 1978. This decline was deepened by later Presidential actions, which produced a further cutback for the Clinch River breeder reactor as well as for the base program. Other nuclear programs showed substantial increases in the 1978 budget request, notably fuel cycle R&D, laser and magnetic fusion, nuclear research and applications, and uranium-enrichment process development. The last program was somewhat reduced by the Congress, but increases for all the rest of the programs were approved.

Direct nonnuclear energy R&D programs accounted for 29 percent of the ERDA total with coal utilization the leading area of effort. This program had been expected to receive lower funding in the budget proposal, but the Congress subsequently granted increases for portions of the program that may result in a 1978 increase for coal utilization overall. ERDA petroleum and natural gas programs and in situ technology are scheduled to increase in 1978. Solar energy development, the second largest nonnuclear program, is scheduled for a substantial increase in 1978 (with funding expected to be at least triple that of 1976). Geothermal energy is also scheduled for an important increase in 1978, and end-use conservation is scheduled to more than double, making this program the third largest on the nonnuclear side.

Another 16 percent of the proposed R&D total for ERDA was devoted to energy-supporting activities in high-energy physics, basic energy sciences, and nuclear physics, and in environmental and health areas. All of these are now scheduled for increases except for health research where a subprogram transfer in 1978 will result in a reduction.

Weapons and testing and naval reactor development both reflected requested increases, which received congressional approval.

- NASA funding has grown steadily since 1974 but is still lower than the levels of the late sixties. The estimated R&D total for 1977 was $3.6 billion, with a 7-percent increase to $3.8 billion requested for 1978. As a share of the Federal R&D total, NASA programs have fallen from 28 percent in 1968 to an estimated 15 percent in 1978.

The principal NASA program is the space shuttle, which accounted for 35 percent of the R&D total proposed for NASA in 1978 and which was subsequently approved by the Congress as requested. The space shuttle is the first reusable space vehicle designed to carry different types of payload to and from low Earth orbit. Although growth in funding has slowed considerably as development enters later stages, the program is still at the $1.3 billion level.

A supporting area, space transportation system (STS) operations capability development, grew almost five times in the 1978 budget request, and this expansion was subsequently approved. Expendable launch vehicle development was reduced, however.

Within the broad NASA space sciences program area are two major subareas: physics and astronomy, up 35 percent in the 1978 budget, and lunar and planetary exploration, down 18 percent. Within physics and astronomy a leading program is the 2.4-meter earth-orbiting space telescope to be launched by the shuttle in 1983 (approved by the Congress). Other programs include high-energy astronomy observatories and the solar maximum mission satellite. The lunar and planetary program reflected the later stages of development exemplified by the Pioneer and Mariner missions and included a new mission, the Jupiter orbiter/probe, which received congressional approval.

NASA space applications programs were expected to grow as a whole, but some individual programs were reduced: earth resources detection and monitoring is scheduled for considerable growth in 1978 while ocean condition and weather monitoring and forecasting programs are down.

The NASA aeronautics research and technology program is large and continues to grow, by an estimated 12 percent in 1978. The emphasis of this program is on aircraft efficiency and performance.

The NASA space research and technology program, another large effort, is expected to grow moderately, as is NASA tracking and data acquisition.

- The small change in the HEW 1978 budget request for R&D programs—from a level just under $3 billion in 1977 to $3 billion in 1978—reflects a high obligational carryover in 1977, resulting from a Presidential veto of the 1976 HEW appropriation that was overridden by the Congress midway in the fiscal year. HEW will account for an estimated 11-percent share of the Federal R&D total in 1978, compared with 8 percent in 1968.

Three-quarters of the R&D effort within HEW is sponsored by the National Institutes of Health (NIH). Cancer and heart and lung research grew rapidly in the early seventies, but in 1977 the increase for each of these areas was 8 percent while the relative increase for each of the other leading health research areas was greater with one exception. Research on aging rose 59 percent; on environmental health, 34 percent; on eye diseases, 31 percent; and on arthritis, metabolism, and digestive diseases, 15 percent. The small relative increases requested for the cancer and for the heart and lung institutes in the President's 1978 budget were augmented by the Congress; at the same time, greater relative increases were given to all the other institutes, especially for research in eye problems, aging, environmental health, and arthritis and metabolism.

The Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA), representing 5 percent of the HEW R&D total, showed scarcely any increase in the budget request for 1978 although mental health research was later increased by the Congress over the budget request level.

The Office of Education (OE) reflected a decrease in 1978, partly from advancing funding to State recipients of a major program component in 1977 (later changed by congressional action). The National Institute of Education (NIE) reflected a requested increase in funding, which was subsequently reduced by the Congress.

- NSF was expected to receive a 10-percent increase in funding for R&D programs in the 1978 budget proposal, bringing the level to more than $750 million. Later congressional action, however, had the effect of reducing this total. NSF represented an estimated 3 percent of the Federal R&D total in the budget, compared with 2 percent in 1968.

  All 14 areas of research project support are scheduled for increases in 1978 as a result of Presidential and congressional actions. The six National Research Centers are scheduled for an increase on a collective basis. The RANN (Research Applied to National Needs) program reflected an increase in the budget request, which was subsequently changed to a reduction by the Congress. The U.S. Antarctic program is scheduled for increased support, and the science education program for a considerable reduction.

- The Department of Agriculture (USDA) showed a moderate increase in the 1978 budget request—up 9 percent from the $525 million level in 1977 to $574 million.

The R&D efforts of the Agricultural Research Service (ARS) account for more than one-half of all USDA research and development. These were placed at a 12-percent growth rate in the 1978 budget request, covering ongoing work on plant and animal production as well as a new competitive grant program open to all kinds of performers for research on long-range food needs. The Cooperative State Research Service (CSRS) is scheduled for a moderate 1978 increase. Grants are provided under this program for research at agricultural experiment stations. Forest Service R&D programs, including forestry, forest disease, and wildlife research, and forest products utilization efforts, are scheduled for a small overall increase.

- The Department of Transportation (DOT) showed a slight R&D decrease in the 1978 budget request, primarily reflecting carryovers in 1977 for some subdivisions. The largest effort within DOT, undertaken by the Federal Aviation Administration on air traffic control and navigation aids, remains at about the same level in 1978. The next largest area is found within the Urban Mass Transportation Administration, and this program is expected to grow considerably to cover ongoing work on new facilities and techniques to improve mass transportation services. Other important areas of R&D effort by DOT are railroad research, highway research, highway traffic safety research, and research to aid Coast Guard operations.

- The increase proposed for the Department of the Interior R&D programs in 1978 was derived primarily from expansion of Geological Survey efforts. These included a special increase for mapping of earthquake geologic hazards and earthquake prediction and smaller increases for sustaining programs. Next in size of R&D support in 1978 is the Bureau of Mines, where a reduction occurred in the budget request, partly from a decline in mined land demonstration activities and some coal mining technology programs, but these activities were restored and increased by the Congress. For Fish and Wildlife Service and Office of Water Research and Technology programs moderately increased support was planned.

- The Environmental Protection Agency (EPA) reflected a 14-percent decrease for R&D activities in the President's 1978 budget request compared with a 39-percent increase in 1977. The 1978 decrease is attributable to large obligational carryovers in 1977. EPA programs fall into two broad groups: those concerned with pollution effects research and those concerned with control and management. Chief areas for decreases in 1978 were air quality control and water quality control, but these decreases probably do not reflect a real decline in activity.

- The Department of Commerce showed a slight decrease in the 1978 budget proposal after having reflected R&D growth of 8 percent in 1977. The chief program activity is sponsored by the National Oceanic and Atmospheric Administration (NOAA), which conducts a number of environmental study programs as well as satellite services and an ocean fisheries and resources program. Growth of 5 percent was expected in NOAA programs overall. Other Commerce R&D efforts are represented by the National Bureau of Standards, the Maritime Administration, and the Economic Development Administration.

- A total of 27 other agencies reported R&D activities in the 1976-78 budget period. Those with the largest programs are the Nuclear Regulatory Commission (NRC) and the Veterans Administration. NRC was expected to receive a 22-percent increase in the 1978 budget to cover reactor safety, environmental, and safeguards research. VA medical and prosthetics research remained at the same level.

Performers

During the 1968-78 decade, as in earlier periods, most R&D funds have been directed to extramural performance. In 1968 the share of the Federal R&D total represented by extramural work was 78 percent. In 1977 the share was an estimated 74 percent—or $18.0 billion. In the 1978 budget the share of R&D work expected to be extramurally performed had risen to 75 percent—or $19.8 billion. Direct work by Federal personnel—intramural performance—amounted to 25 percent, or $6.5 million, based on the 1978 budget.

INDUSTRY

In 1968 performance by industrial firms (including FFRDC's) accounted for 59 percent of the Federal R&D total, but thereafter a declining trend was noted in the share of work performed by this sector, largely because of less emphasis on DOD and NASA programs and greater emphasis on HEW, NSF, and other "civilian" programs, where performance is directed more to universities or intramural groups than to industry.

Federal obligations for research and development by performer

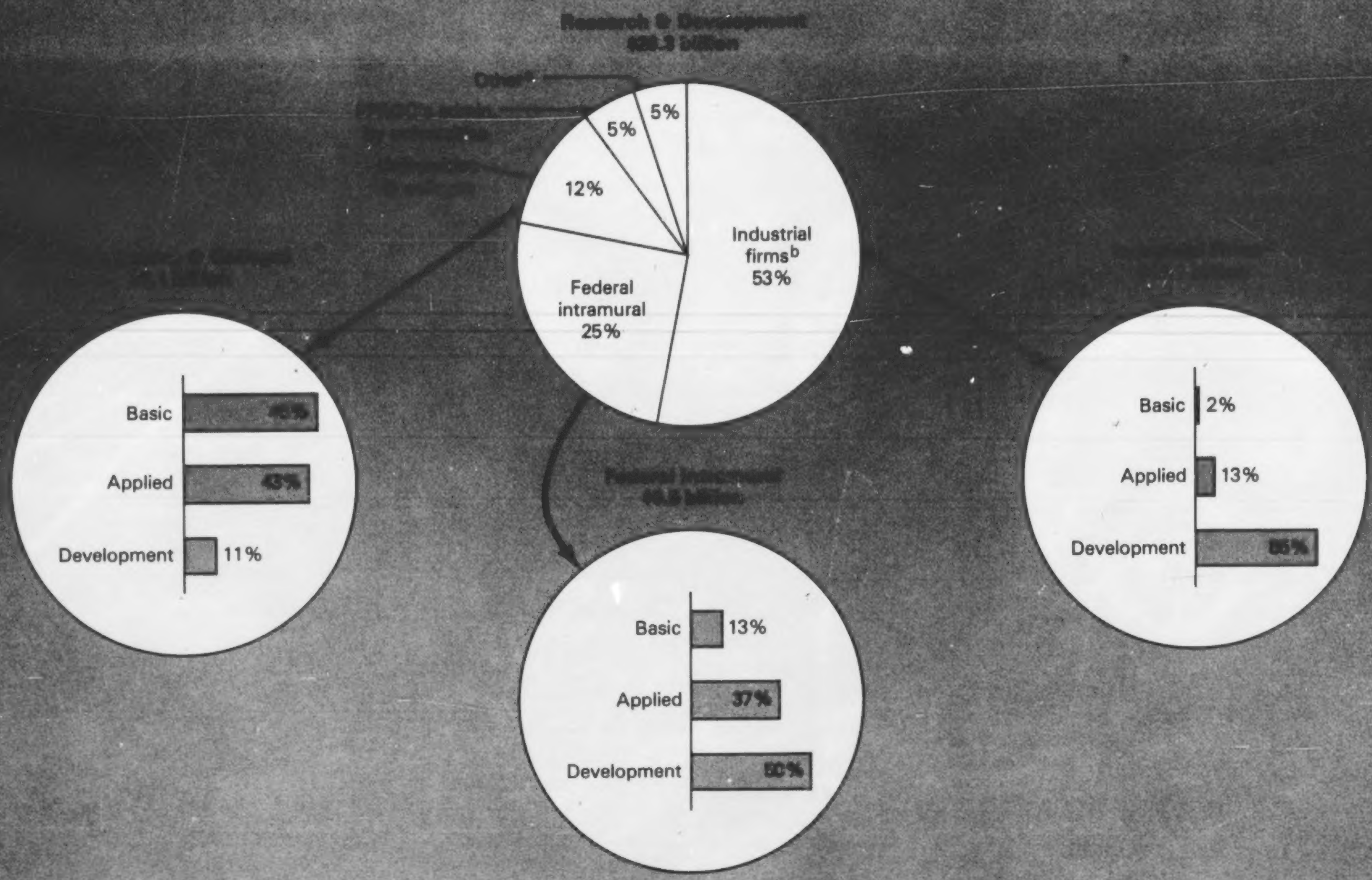
[Dollars in millions]

Performer	Actual			Estimates			
	1968	1976	Average annual percent change 1968-76	1977	Percent change 1976-77	1978	Percent change 1977-78
Total	$15,921	$20,759	+3.4	$24,465	+17.9	$26,317	+7.6
Federal intramural	3,493	5,710	+6.3	6,467	+13.3	6,548	+1.3
Industrial firms	9,047	9,415	+.5	11,402	+21.1	12,919	+13.3
FFRDC's[1] administered by industrial firms	412	849	+9.5	1,062	+25.1	1,150	+8.3
Universities and colleges	1,482	2,526	+6.9	2,851	+12.9	3,060	+7.3
FFRDC's[1] administered by universities	611	1,061	+7.1	1,195	+12.6	1,217	+1.8
Other nonprofit institutions	383	693	+7.7	769	+11.0	772	+.4
FFRDC's[1] administered by nonprofit institutions	339	231	-4.7	253	+9.5	221	-12.6
State and local governments	100	202	+9.2	365	+80.7	353	-3.3
Foreign performers	54	73	+3.8	102	+39.7	78	-23.5

[1] Federally funded research and development centers.

SOURCE: National Science Foundation

Federal obligations for research and development, by performer and character of work: FY 1978 (est.)



[a] Includes other nonprofit institutions, FFRDC's administered by nonprofit institutions, State and local governments, and foreign performers.

[b] Includes federally funded research and development centers (FFRDC's) administered by this sector.

SOURCE: National Science Foundation.

Since 1975, however, the industrial share has risen steadily as DOD and NASA programs have shown greater growth and as ERDA has placed increasing emphasis on industrial performance. In 1977 the industry share of total Federal R&D obligations was an estimated 51 percent compared with an estimated 53 percent in 1978. The increasing funds allotted to industry in the current budget period (1976-78) may be reflected in a reversal of the decline in industry employment of scientists and engineers recorded in 1970-75.

In 1977 an estimated 86 percent of the Federal support to industrial firms was directed to development, 13 percent to applied research, and 2 percent to basic research.

INTRAMURAL

Although obligations for Federal intramural R&D erformance have grown steadily from 1968 onward, the share of intramural work within the Federal R&D total has traced a course exactly the reverse of industrial performance. The intramural share grew until 1975 and thereafter has been declining.

Intramural performance accounted for 22 percent of the total in 1968, grew to more than 28 percent in 1975 but dropped to an estimated 26 percent in 1977 and 25 percent in 1978. Federal intramural performance covers costs associated with the administration of extramural programs by Federal personnel as well as costs of direct R&D performance.

DOD was expected to account for nearly one-half of the Federal intramural total in 1977 and 1978, followed by NASA with nearly one-fifth, and HEW with nearly one-tenth. In 1968 the DOD and NASA shares were larger and the HEW share smaller. As HEW intramural work has grown in the 1968-78 decade, so has that of the Departments of Agriculture (USDA), the Interior, and Commerce.

In 1977 an estimated 51 percent of the support for intramural performance was directed to development, 37 percent to applied research, and 12 percent to basic research.

UNIVERSITIES AND COLLEGES

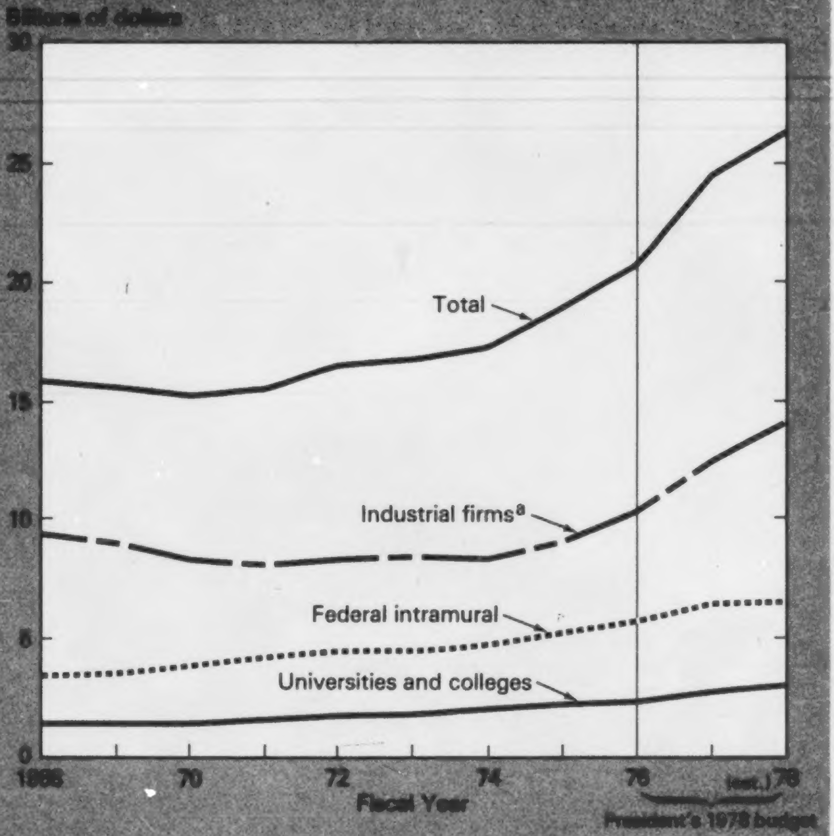
Federal support to universities and colleges (excluding FFRDC's) has increased almost steadily over the 1968-78 decade, from $1.5 billion to an estimated $3.1 billion (the only drop occurring in 1970). Work by this sector accounted for 9 percent of the Federal R&D total in 1968, but by 1977 the share was 12 percent with the same share anticipated in 1978.

In the current (1976-78) period support is not only rising in current dollars but also in constant dollars—an estimated 7 percent in two years.

Following the pattern of recent years HEW continues to account for one-half of the total Federal R&D support to universities and colleges, slightly more than in 1968. NSF has increased support from 15 percent to 18 percent of the Federal total in the 1968-78 timespan. DOD, the third agency in size of support, has moved from 16 percent in 1968 to an estimated 10 percent in 1978. Currently, ERDA is the fourth agency, now ahead of USDA.

In 1977 the basic research component of university-and-college performance was an estimated 45 percent; applied research, 44 percent; and development, 11 percent.

Trends in Federal R&D obligations by major performer



[a] Includes federally funded research and development centers (FFRDC's) administered by this sector.

SOURCE: National Science Foundation

Research by Fields of Science

Six agencies submitted program data on research performed at universities and colleges by field of science. These agencies—HEW, DOD, USDA, NSF, ERDA, and NASA—make up 95 percent of the total Federal research support to universities and colleges in the current (1976-78) budget period. Their combined support in 1977 was $2.4 billion and in 1978 will be an anticipated $2.6 billion.

The life sciences accounted for 57 percent of the total research support of these agencies in 1977, with approximately one-half the funds directed to the biological sciences. The physical sciences represented 13 percent, with greatest emphasis on physics and chemistry. Engineering represented 9 percent of the total research effort; environmental sciences, 8 percent; social sciences, 5 percent; and mathematics and computer sciences and psychology, 3 percent each. All of these fields showed estimated growth in support in 1978 with the physical sciences showing the greatest relative increase.

HEW provides most of the support to the life sciences, social sciences, and psychology, although support for psychology dropped slightly in the 1978 estimate. NSF provides the most support to the physical sciences, environmental sciences, and mathematics and computer sciences in 1978. DOD accounts for most funds for engineering research, followed by NSF.

OTHER NONPROFIT

Federal support to other nonprofit institutions (including FFRDC's) increased in 1977 but dropped slightly in 1978. The share of this sector within the Federal R&D total in the 1976-78 period is approximately 4 percent, the same share as in 1968. In 1977 the effort of nonprofit institutions that was directed to development was 46 percent; to applied research, 42 percent; and to basic research, 12 percent.

HEW, the largest support agency, provided 41 percent of the 1977 total. DOD provided 26 percent.

STATE AND LOCAL GOVERNMENTS

Federal support for State and local governments R&D activities showed a substantial increase in 1977, almost doubling, chiefly because of expected advanced funding to the States that year for one education program within HEW. HEW was responsible for an estimated 65 percent of the support to this sector in 1977. Support dropped in 1978 largely because the education program reverted to a normal level. The State and local government share of the Federal R&D total is 1 percent in each year of the current (1976-78) period. Most work performed by this sector is devoted to development.

FFRDC's

Federally funded research and development centers (FFRDC's) are R&D-performing or -managing organizations exclusively or substantially financed by one or more Federal agencies and administered for them by industrial firms, universities, or other nonprofit institutions. In 1977 six Federal agencies were the sponsors of 36 FFRDC's.

In 1968 support to FFRDC's administered by universities accounted for 52 percent of total Federal support to this sector; FFRDC's administered by industrial firms accounted for 30 percent; and FFRDC's administered by other nonprofit institutions represented 17 percent. During the 1968-78 decade FFRDC support has steadily increased most notably for those administered by the industrial sector. By 1977 the share of the total that was industry-administered had risen to 42 percent, and the share that was university-administered had fallen to 48 percent.

ERDA is the primary source of support for FFRDC's, providing an estimated 71 percent of the total in 1977, compared with 65 percent in 1968. DOD is the second largest sponsor, providing an estimated 17 percent of the total in 1977.

Federal R&D obligations to FFRDC's[1] by administering sector and agency: FY 1978 (est.)

[Dollars in millions]

Sector	All agencies	ERDA	DOD	NRC	NASA	HEW	NSF	Other
Total	$2,587.5	$1,959.1	$288.8	$111.5	$77.5	$62.3	$59.8	$28.5
Industrial firms	1,150.0	922.6	90.2	87.7	—	46.0	2.9	.6
Universities and colleges	1,217.0	972.6	78.6	19.4	75.0	12.0	55.1	4.3
Other nonprofit institutions	220.5	63.9	120.0	4.4	2.5	4.3	1.8	23.6

[1] Federally funded research and development centers.

SOURCE: National Science Foundation

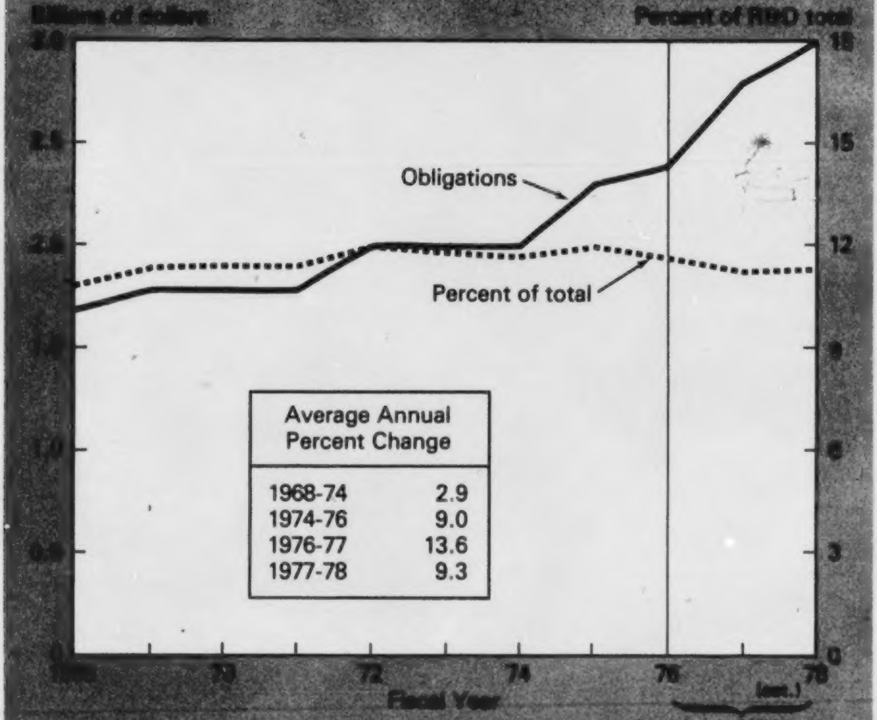
Section 3. BASIC RESEARCH

- Federal basic research obligations grew from $1,721 million in 1968 to $2,425 million in 1976—or an averge annual gain of 4.4 percent. The increase to an estimated $2,755 million in 1977 and $3,012 million in 1978 represented growth of 13.6 percent and 9.3 percent, respectively.

- Despite a significant upward funding trend since 1975, basic research obligations, as shown in the President's budget request for 1978, were 5 percent lower than in 1968 in constant dollars.

- The basic research share of the Federal R&D total was 11 percent in 1968 compared with 12 percent in 1976 and an estimated 11 percent in both 1977 and 1978.

- In the next few years the trend in basic research funding is likely to continue upward as a result of Federal policy to support this kind of activity at levels that will produce real growth. Based on recent decisions, the agencies that will be responsible for most of the increased support are NSF, NASA, DOD, and ERDA.



Trends in Federal basic research obligations

SOURCE: National Science Foundation

Agencies

- The five largest support agencies—HEW, NSF, ERDA, NASA, and DOD—account for approximately 85 percent of the Federal basic research total in the 1976-78 period. The same five agencies led in basic research support in 1968 but accounted for slightly more of the total—88 percent. The increasing support for basic research by USDA and the Interior in recent years has caused a drop in the aggregate share of the leading five agencies. In 1978 the anticipated increase for USDA was chiefly attributable to the new competitive grant research fund as well as expansion of work in photosynthesis and nitrogen fixation by the Agricultural Research Service. For Interior an increase was chiefly for work in earthquake prediction on the part of the Geological Survey.

- Throughout the 1968-78 period HEW has been the leading support agency for basic research. The HEW share of the basic research total grew from 23 percent in 1968 to a high of 28 percent in 1974. The 1978 share is an estimated 26 percent. The National Institutes of Health (NIH) account for approximately nine-tenths of the HEW basic research total. The Institutes fund programs to further knowledge in the biomedical sciences as to the bases of health and disease and methods of diagnosis and treatment. Their small increase in 1978 reflected funds carried over in 1977 from 1976 because of a late appropriation that year. Much of the 1978 increase for HEW was attributable to the National Institute of Education.

- Support for basic research on the part of NSF remained nearly unchanged between 1968 and 1970, after which time steady upward growth began. The proposed 1978 amount was more than two and one-half times the 1968 amount. The NSF share of all Federal basic research support in 1968 was 15 percent, compared with 22 percent in 1976 and an estimated 22 percent in 1978. Of the growth proposed for federally funded basic research in 1978 over 1977 NSF accounted for the largest amount, more than one-fourth of the total. This was to cover work in all the science disciplines and engineering and included an emphasis on basic work related to earthquake prediction. Only NSF and the Smithsonian Institution support basic research solely as a national resource instead of a fulfillment of other broad-mission objectives. Between 1968 and 1978 the growth in basic research funding for these agencies was 167 percent compared with 59 percent for the mission-oriented agencies.

- ERDA basic research funding has been growing steadily since 1974. The ERDA basic research effort is largely directed to physics—specifically to the basic energy sciences—to gain an understanding of the fundamental nature of matter and energy, and to high-energy physics to study the interaction and transformation of the smallest consitutents of matter. The 1978 level, as shown in the budget, was almost twice the 1974 support level, but the share within all Federal basic research has dropped to 14 percent from 16 percent in 1968.

Federal obligations for basic research by agency

[Dollars in millions]

Agency	Actual			Estimates			
	1968	1976	Average annual percent change 1968-76	1977	Percent change 1976-77	1978	Percent change 1977-78
Total	$1,721	$2,425	+4.4	$2,755	+13.6	$3,012	+9.3
Department of Health, Education, and Welfare	397	652	+6.4	747	+14.6	773	+3.5
National Science Foundation	252	524	+9.6	606	+15.6	677	+11.7
Energy Research and Development Administration[1]	282	346	+2.6	391	+13.0	429	+9.7
National Aeronautics and Space Administration	321	293	-1.1	320	+9.2	365	+14.1
Department of Defense	263	248	-.7	275	+10.9	314	+14.2
Other agencies	206	362	+7.3	416	+14.9	454	+9.1

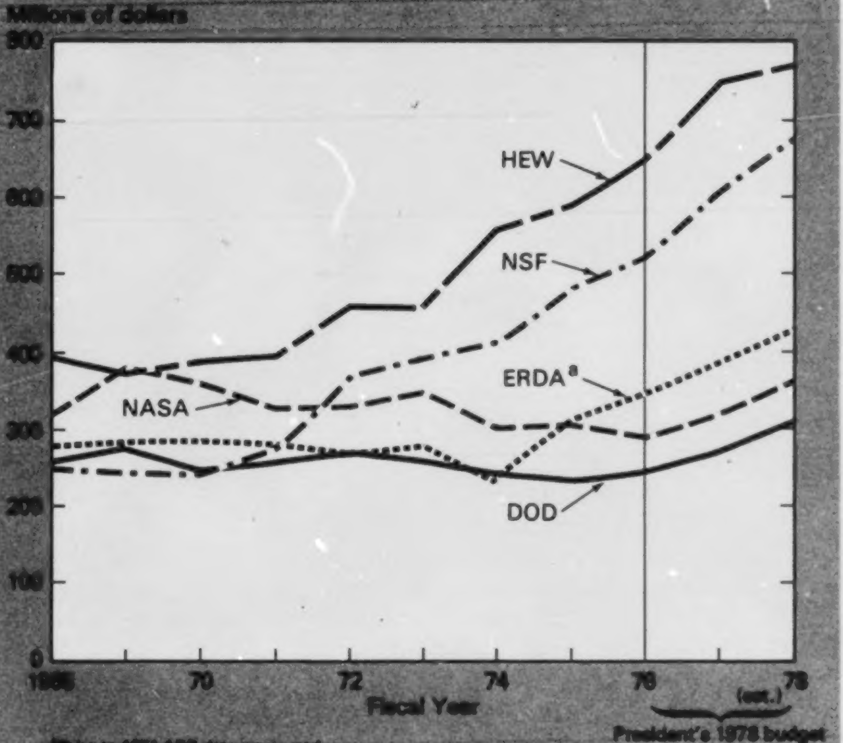
[1] Atomic Energy Commission prior to 1974.

SOURCE: National Science Foundation

- NASA showed increased support for basic research in 1977 and 1978, but these levels were still less than the 1969 high. The NASA share of the Federal basic research total in the 1976-78 period is 12 percent compared with 19 percent in 1968 and 21 percent in 1969. After that year a general decline took place through 1976. The NASA basic research effort in 1978 is primarily related to the study of the Earth's upper atmosphere to assess the physical effects of natural and man-caused events.

- DOD support for basic research has fluctuated throughout the 1968-78 decade, remaining below the 1969 level until the 1978 budget proposal, which included a 14-percent increase. DOD basic research activities were curtailed following the Mansfield Amendment to the military authorization for fiscal year 1970 that restricted research to that with a direct relationship to a specific military function or operation. In the 1976 budget, however, a DOD policy was initiated to reverse a long-term decline in technology base efforts, which has had some effect on basic research funding. Currently DOD supports basic research chiefly in metallurgy, materials, engineering, oceanography, and physics. The DOD share within the Federal basic research total has fallen from 15 percent in 1968 to an estimated 10 percent in 1978.

Trends in Federal obligations for basic research by agency



aPrior to 1974 AEC data were used.

SOURCE: National Science Foundation

Performers

- Universities and colleges have always been the largest performing sector for federally funded basic research. The 1968 share of Federal basic research total for this sector was 43 percent, dropping slightly in later years, and increasing to 47 percent by 1975. The 1978 share is an estimated 46 percent. HEW has provided the largest amount of support in each year of the 1968-78 timespan except 1973 when NSF provided more. At present each agency provides more than one-third of the basic research support to the university-and-college sector, much of the HEW funding directed to support at medical schools. NSF awards grants on a competitive basis for research project support to institutions of higher education in every State. In fact, one-half the growth of $109 million for this sector shown in the 1978 budget was attributable to NSF. However, DOD, ERDA, and NASA also showed increased support in 1978. Their combined shares amounted to one-fifth of the total.

- The Federal intramural sector has been the second largest for basic research performance in the 1968-78 period. In the 1978 budget the share was an estimated 30 percent.

- NASA is the chief support agency for intramurally performed basic research, accounting for 21 percent of the total in 1968 and an estimated 19 percent in 1978. The share of HEW has increased from 17 percent to an estimated 19 percent in the same time period. DOD was the second largest support agency until 1975, but the DOD share is only 13 percent at present. Both USDA and Interior have been increasing intramural performance of basic research since 1968.

- FFRDC's administered by universities make up the third largest performance sector for Federal basic research. The 1978 share of the basic research total for this sector was an estimated 12 percent, based on the budget, compared with 13 percent in 1968. ERDA accounts for more than four-fifths of the total support to university-administered FFRDC's.

- Federal support for basic research performed by industrial firms (including FFRDC's) remained below the 1968 level of funding until the 1978 budget. The industrial share of the basic research total was 13 percent in 1968 but had dropped to 6 percent by 1974. Growth since then is reflected in the 8-percent share estimated for 1978. Both the decline in use and the recent growth for this sector are attributable to NASA more than any other agency, but ERDA has made an important contribution to the rise since 1975.

Federal obligations for basic research by performer

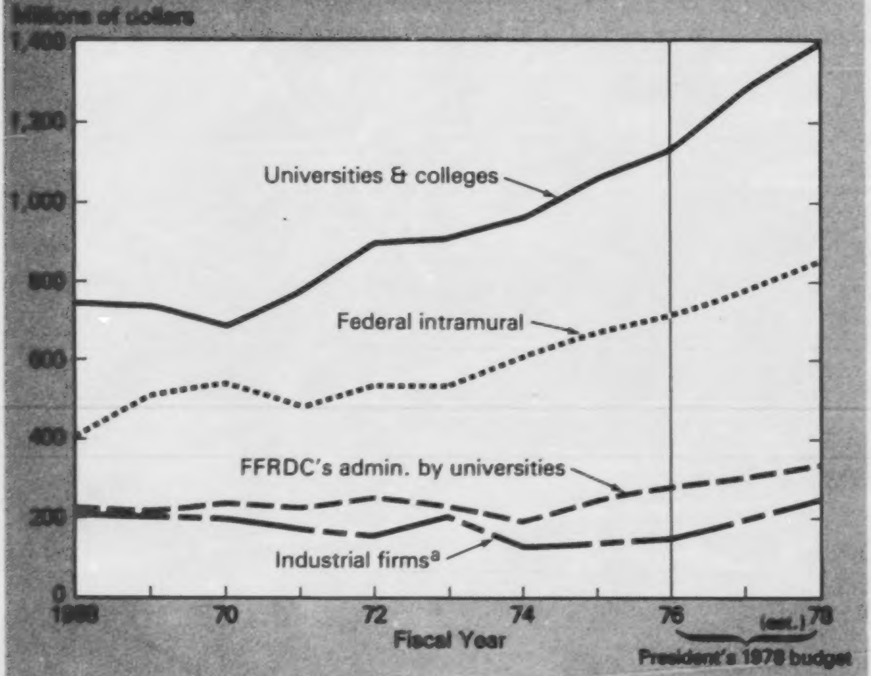
[Dollars in millions]

Performer	Actual			Estimates			
	1968	1976	Average annual percent change 1968-76	1977	Percent change 1976-77	1978	Percent change 1977-78
Total	$1,721	$2,425	+4.4	$2,755	+13.6	$3,012	+9.3
Federal intramural	410	719	+7.3	791	+10.0	851	+7.6
Industrial firms[1]	218	152	-4.4	201	+32.2	250	+24.4
Universities and colleges	745	1,137	+5.4	1,290	+13.5	1,399	+8.4
FFRDC's administered by universities	225	284	+3.0	315	+10.9	347	+10.2
Other nonprofit institutions[1]	97	108	+1.4	125	+15.7	131	+4.8
Other performers	27	25	-1.0	33	+32.0	34	+3.0

[1] Includes federally funded research and development centers administered by this sector.

SOURCE: National Science Foundation

Trends in Federal basic research obligations by major performer



[a] Includes federally funded research and development centers (FFRDC's) administered by industrial firms.
SOURCE: National Science Foundation

Fields of Science

- Performance of basic research by fields of science shifted somewhat during the 1968-78 period. The life sciences began receiving the largest share of support in 1972; prior to that year the physical sciences had received the largest share.

- The life sciences accounted for an estimated 35 percent of the basic research total in the 1978 budget, and HEW represented more than three-fifths of this support followed by USDA with less than one-sixth.

- The physical sciences made up an estimated 30 percent of the total basic research effort in 1978. ERDA has always been the largest support agency, providing more than one-third of all support in 1978. NASA and NSF make up most of the rest.

- The environmental sciences share of the basic research total increased from 12 percent in 1968 to an estimated 15 percent in 1978. The two major sources of funds have been NSF and Interior, followed by DOD and NASA.

- Engineering represented 10 percent of the basic research total in the current (1976-78) period, compared with 9 percent in 1968. DOD, NSF, ERDA, and NASA have been the major support agencies, their combined shares accounting for over nine-tenths of the total in 1978.

- The social sciences accounted for 4 percent of the total basic research effort in almost each year of the 1968-78 period. Nearly two-fifths of the support was provided by NSF in the 1978 budget, followed by HEW with one-fourth. USDA is another important source of funds to this field.

Federal obligations for basic research by field of science

[Dollars in millions]

Field of science	Actual		Estimates	
	1968	1976	1977	1978
Total	$1,721	$2,425	$2,755	$3,012
Life sciences	579	878	1,007	1,058
Psychology	55	44	53	57
Physical sciences	599	722	806	911
Astronomy	110	159	180	220
Chemistry	119	175	203	222
Physics	352	383	416	460
Other	18	5	8	9
Environmental sciences	199	355	394	438
Atmospheric sciences	107	119	128	132
Geological sciences	51	140	155	184
Oceanography	40	87	100	110
Other	1	8	10	12
Mathematics and computer sciences	67	70	79	88
Engineering	156	240	268	297
Social sciences	61	85	102	113
Other sciences	4	33	46	49

SOURCE: National Science Foundation

Section 4. APPLIED RESEARCH

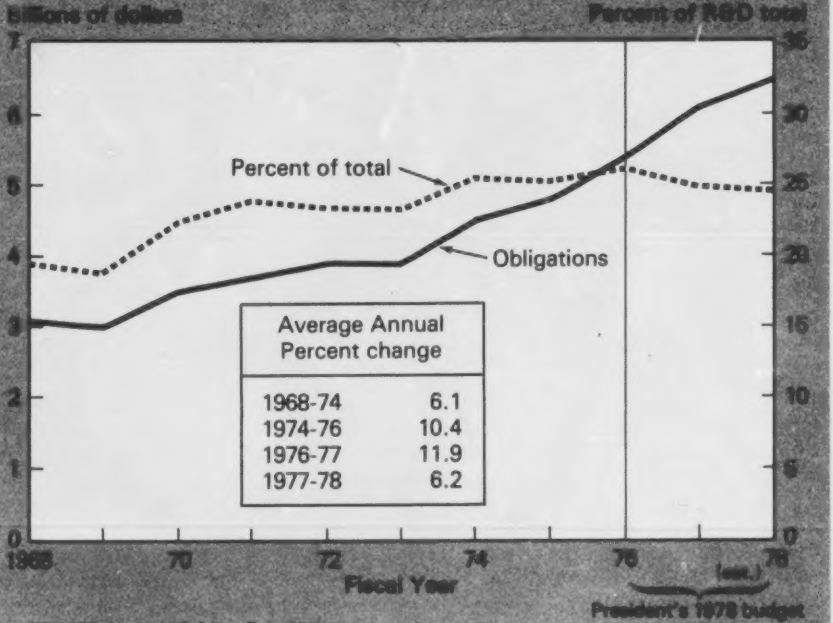
- Support for Federal applied research grew from $3,140 million in 1968 to $5,448 in 1976 and was an estimated $6,099 in 1977 and $6,479 in the 1978 budget proposal. These figures represent a 7.1-percent average annual increase in the 1968-76 period followed by an 11.9-percent increase in 1977 and a 6.2-percent increase in 1978.

- Applied research funding has stayed ahead of inflation in most years so that in 1978 the estimated level is 13 percent higher than the 1968 level on a constant-dollar basis.

- The applied research share of the Federal R&D total in 1968 was 20 percent and has shown general growth over the 10-year span. In 1978 and 1977 the estimated shares are each 25 percent, one percentage point less than in 1976, the high point.

- Applied research support is currently showing no real growth or decline but is remaining steady. The likelihood is that this condition will remain unchanged in the near term in the absence of any governmentwide applied research policy. The same agencies—DOD, HEW, and NASA— can be expected to remain the leaders, but virtually all Federal agencies will support applied research efforts.

Trends in Federal applied research obligations



Average Annual Percent change	
1968-74	6.1
1974-76	10.4
1976-77	11.9
1977-78	6.2

SOURCE: National Science Foundation

Agencies

- DOD, HEW, and NASA have been the primary sponsors of applied research throughout the 1968-78 period. Their combined shares accounted for an estimated 83 percent of the applied research total in 1968, compared with 73 percent in 1976. Other Federal agencies have increased applied research activities in recent years, most notably ERDA, USDA, and the Department of Commerce. Thus, in the 1978 budget proposal the share of the three largest agencies had decreased to an estimated 72 percent.
- DOD has sponsored more applied research than any other agency in the 1968-78 decade. At the present time, however, HEW is sponsoring almost an equal amount (and more in the 1977 estimate). The share for DOD of 28 percent in 1976 compares with 42 percent in 1968. DOD support gained significantly in 1972, and again in 1977 and 1978, but from 1974 onward the other chief support agencies have tended to increase their applied research funding more rapidly. All three services and the Defense Agencies contribute to the DOD applied research total, but the Air Force is the leading source of support by far.
- The HEW level of support for Federal applied research has more than doubled in the 1968-78 period. In 1977 HEW was the largest agency sponsor of applied research. The HEW share of the applied research total was 24 percent in 1968 but had moved to 28 percent in 1976 and 1977. In the current (1976-78) period dollar increases are largely based on programs of the National Institutes of Health.
- The NASA level of support for applied research has nearly doubled between 1974 and 1978 after showing no sustained growth in the 1968-74 period when the Apollo program was phasing down. However, the 1978 increase proposed for NASA applied research activities was second largest among all Federal agencies after DOD. NASA applied research support is currently directed to the aeronautical research and technology program, to the space shuttle, to earth resources detection and monitoring, environmental quality monitoring, ocean earth dynamics, and weather monitoring and forecasting, space communications, and the maintenance of a strong technology base. The NASA share of all Federal applied research was 17 percent in 1976 and an estimated 16 percent in 1978.

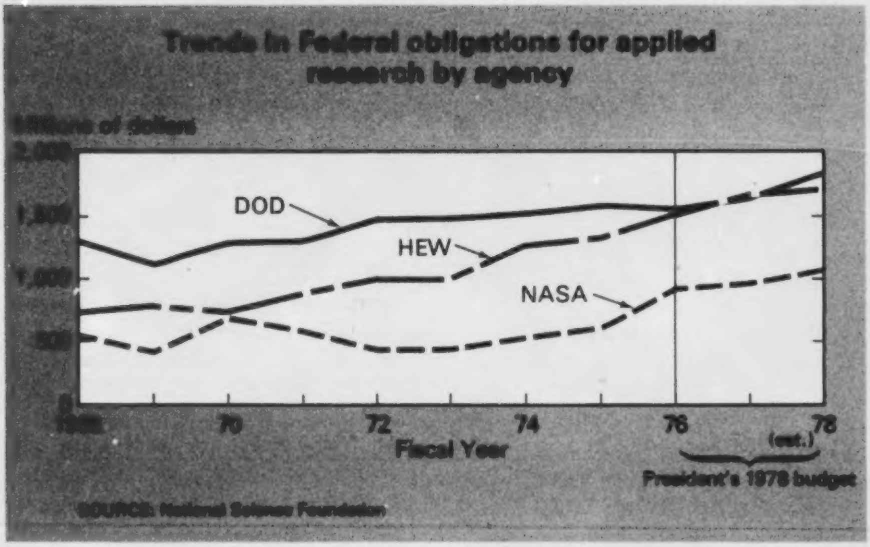
Federal obligations for applied research by agency

[Dollars in millions]

Agency	Actual			Estimates			
	1968	1976	Average annual percent change 1968-76	1977	Percent change 1976-77	1978	Percent change 1977-78
Total	$3,140	$5,448	+7.1	$6,099	+11.9	$6,479	+6.2
Department of Defense	1,313	1,539	+2.0	1,677	+9.0	1,864	+11.2
Department of Health, Education, and Welfare	750	1,511	+9.2	1,683	+11.4	1,716	+2.0
National Aeronautics and Space Administration	536	930	+7.1	991	+6.6	1,061	+7.1
Energy Research Development Administration[1]	120	401	+16.3	489	+21.9	543	+11.0
Department of Agriculture	140	271	+8.6	307	+13.3	335	+9.1
Environmental Protection Agency	—	142	—	193	+35.9	166	-14.0
Department of Commerce	30	133	+20.0	150	+12.8	150	—
Department of the Interior	102	127	+2.8	140	+10.2	142	+1.4
Nuclear Regulatory Commission	—	88	—	114	+29.5	139	+21.9
Veterans Administration	38	76	+9.1	86	+13.2	87	+1.2
National Science Foundation	6	72	+37.0	69	-4.2	72	+4.3
Department of Transportation	51	31	-6.0	46	+48.4	37	-19.6
Other agencies	54	127	+11.3	154	+21.3	167	+8.4

[1] Atomic Energy Commission prior to 1974.

SOURCE: National Science Foundation



Trends in Federal obligations for applied research by agency

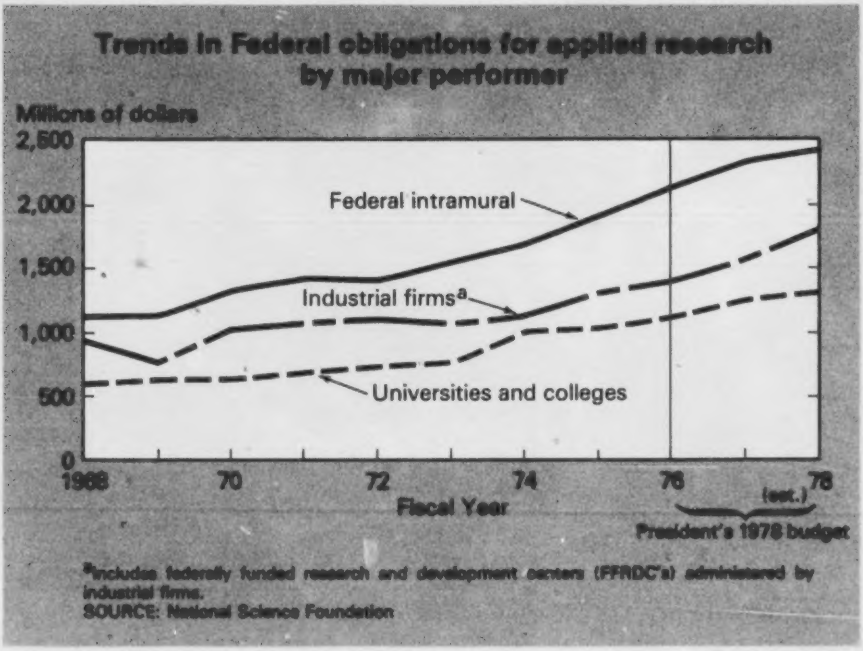
SOURCE: National Science Foundation

- ERDA is the fourth largest sponsor of applied research in the 1978 budget, having more than doubled such activities since 1974. The 1977 increase of an estimated 22 percent and the 1978 estimated increase of 11 percent are among the highest of any agency for those years. The ERDA share of the Federal applied research total has increased from 4 percent in 1968 to 7 percent in 1976 and an estimated 8 percent in 1978. Most funds are directed to work in physics, geological and atmospheric sciences, chemical engineering, and the life sciences, and cover nuclear and nonnuclear technology applications and environmental health and safety assessment.

- The USDA applied research effort almost doubled between 1968 and 1976 and in 1977 and 1978 showed estimated growth of 13 percent and 9 percent, for those respective years, reflecting increased public interest in food problems. The 1968 share of the applied research total was 4 percent but is still only an estimated 5 percent in 1977 and 1978. Much of the recent program growth can be attributed to work by the Agricultural Research Service in pest control, application of remote sensing technologies to meeting problems related to reduction of ozone as it affects agriculture, conservation of soil and land resources, and biological sciences related to plant production. Work by the Forest Service has also contributed to these increases.

Performers

- Federal laboratories have traditionally focused more on applied research than other kind of R&D activity, and thus it is not surprising that the intramural sector accounts for the largest share of Federal applied research obligations—36 percent in 1968 and 39 percent in 1976, with the estimated share in 1978 placed at 38 percent. Gradual growth in support has been shown in the 1968-78 decade. Until recently DOD was the largest sponsor of intramurally performed applied research, but since 1976 NASA has been the leading agency with much of the growth connected with the space shuttle. Absolute funding fell for DOD after 1974 but had started to rise again in the 1977 and 1978 estimates, especially on the part of the Army. After 1974 DOD inititated a policy of decreasing the use of its laboratories and increasing the use of industrial firms for work in technology base (much of it applied research). HEW has, in most years, been the third largest sponsor of in-house applied research (except for 1973 when it was the second largest) with steady growth recorded from 1971 onward. Both USDA and Commerce have reflected recent growth in the use of the intramural sector, which has had the effect of increasing their relative contribution to total Federal support.



Trends in Federal obligations for applied research by major performer

[a]Includes federally funded research and development centers (FFRDC's) administered by industrial firms.
SOURCE: National Science Foundation

- Industrial firms (including FFRDC's) have made up the second largest performing sector for applied research in all years of the 1968-78 decade, but growth has been significant only from 1974 onward. The increase of $233 million expected in 1978 was the highest among all sectors. Nearly four-fifths of this increase was attributed to DOD. The industrial total has been most affected by DOD since this agency has historically sponsored more industrially performed applied research then any other. NASA is another important source of support to this sector, especially since 1974. Only in 1977, however, did the NASA level reach and surpass that of 1968. In the current (1976-78) period ERDA and HEW are showing increased support to industrial firms for applied research projects.
- Universities and colleges show steady growth over the 1968-78 period in applied research work. HEW has been primarily responsible for this growth. Awards to the academic sector for Federal applied research activities have made up approximately one-fifth of the Federal applied research total in almost all years of the decade and of these awards, HEW has accounted for approximately two-thirds. Much of this support is directed to medical schools for health-related research. DOD, the next support agency, shows moderate growth in the current period, and USDA shows very significant increases; the 1978 increase is related to the new competitive grant program.
- Support for nonprofit institutions has increased gradually over the 1968-78 period so that at present this group represents 7 percent of the applied research total. HEW is the largest sponsor of the applied research performed by this sector, representing more than one-half the support.

Federal obligations for applied research by performer

[Dollars in millions]

Performer	Actual			Estimates			
	1968	1976	Average annual percent change 1968-76	1977	Percent change 1976-77	1978	Percent change 1977-78
Total	$3,140	$5,448	+7.1	$6,099	+11.9	$6,479	+6.2
Federal intramural	1,141	2,149	+8.2	2,371	+10.3	2,446	+3.2
Industrial firms[1]	951	1,395	+4.9	1,577	+13.0	1,810	+14.8
Universities and colleges	587	1,130	+8.5	1,255	+11.1	1,321	+5.3
FFRDC's administered by universities	154	265	+7.0	317	+19.6	313	-1.3
Other nonprofit institutions[1]	202	392	+8.6	424	+8.2	445	+5.0
Other performers	106	176	+1.1	155	+33.6	144	-7.1

[1] Includes federally funded research and development centers administered by this sector.

SOURCE: National Science Foundation

Fields of Science

- Engineering has always represented the largest share of the Federal applied research effort. In 1968 engineering accounted for 43 percent of the total and in 1978, for an estimated 39 percent. DOD now sponsors nearly one-half the engineering total compared with nearly two-thirds in 1968. NASA has recently increased support to this field, and since 1974 NRC has become another important support agency. In the 1978 budget proposal the NASA share was 33 percent and the NRC share an estimated 6 percent.

- The life sciences were expected to account for 32 percent of the applied research total in the 1978 budget compared with 30 percent in 1968. HEW has been the largest sponsor of work in this field in the 1968-78 period, accounting for approximately seven-tenths of the total. However, USDA, DOD, and ERDA have increased support in recent years.

- Funding for the physical sciences showed an overall decline between 1968 and 1975, largely as a result of decreasing DOD efforts. But support grew by 32 percent from 1976 to 1978 as a result of the expansion of ERDA programs. Until the current period (1976-78) DOD was the main sponsor of applied research in the physical sciences, but at present DOD accounts for one-third of all support while ERDA accounts for more than two-fifths.

- Support for the environmental sciences increased one and one-half times between 1968 and 1978, and in the 1978 budget represented an estimated 8 percent of the Federal applied research effort. NASA, DOD, and ERDA are the chief sponsors of such work. In the 1978 budget NASA accounted for an estimated 37 percent, DOD for 22 percent, and ERDA for 20 percent.

- Funding for applied research in the social sciences has gradually grown between 1968 and 1978. The share of all applied research in 1968 was 4 percent and in 1978 an estimated 6 percent. HEW has been responsible for nearly one-half of the support to this field. USDA and NSF have also contributed importantly.

- Psychology was expected to account for 2 percent of the applied research total in 1978, with four-fifths of the funds coming from DOD and HEW.

- Mathematics and computer sciences was expected to account for 1 percent of the applied research total in 1978. Although the share of the total has dropped from 2 percent in 1968, overall support to this field has been increasing steadily. The largest sponsor is DOD, accounting for approximately three-fifths of the total in 1978.

Federal obligations for applied research by field of science

[Dollars in millions]

Field of science	Actual		Estimates	
	1968	1976	1977	1978
Total	$3,140	$5,448	$6,099	$6,479
Life sciences	925	1,768	1,976	2,047
Psychology	44	97	112	121
Physical sciences	401	499	599	659
Astronomy	34	4	4	4
Chemistry	120	150	168	169
Physics	230	296	358	395
Other	17	49	69	91
Environmental sciences	191	416	459	487
Atmospheric sciences	86	172	189	193
Geological sciences	65	91	103	112
Oceanography	33	73	84	83
Other	7	81	83	99
Mathematics and computer sciences	53	83	86	96
Engineering	1,346	2,138	2,334	2,514
Social sciences	133	305	355	369
Other sciences	47	143	178	186

SOURCE: National Science Foundation

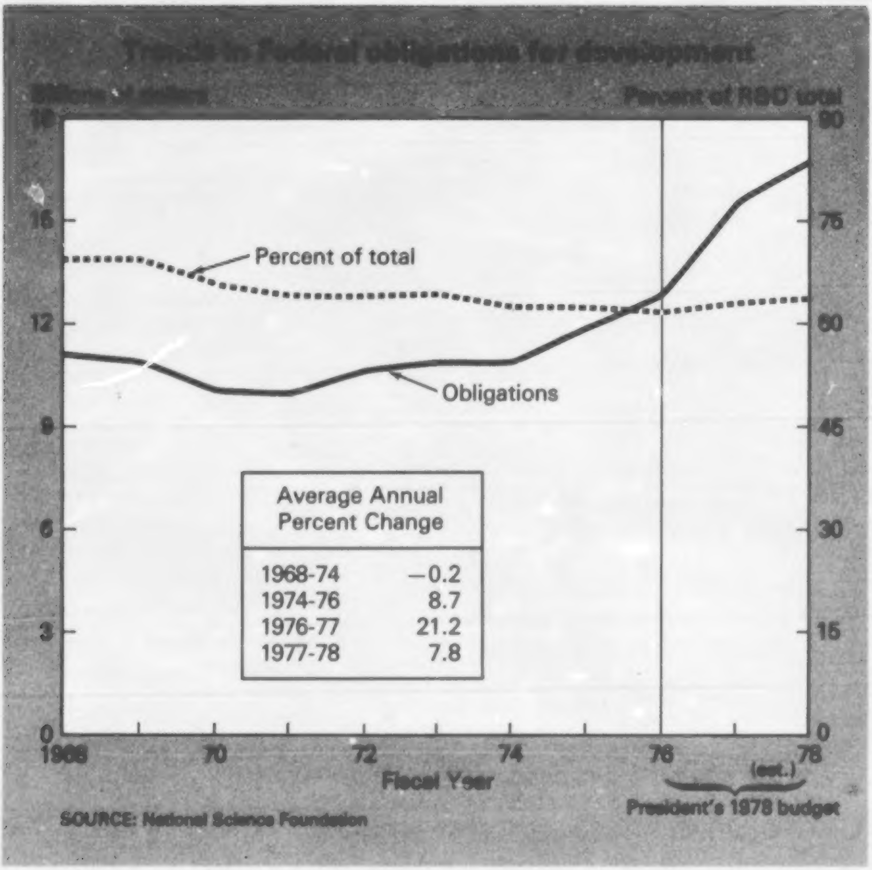
Section 5. DEVELOPMENT

- Federal obligations for development amounted to $12.9 billion in 1976,an estimated $15.6 billion in 1977, and an estimated $16.8 billion in 1978. This growth represented a 21-percent increase in 1977 and 8 percent in 1978.

- Although current funding for development is considerably higher than the $11.1 billion obligated in 1968, a loss of 17 percent in real (constant dollar) performance is seen between 1968 and 1978.

- The development share of the Federal R&D total fell from a high for the decade of 70 percent in 1969 to 62 percent in 1976 but rose to an estimated 64 percent in 1977 and again in the 1978 budget. The recent growth is attributable to DOD programs, to rapid expansion of ERDA programs, and to smaller increases on the part of NASA.

- Despite recent growth that has represented a real expansion of federally supported development activities, the outlook for continued growth suggests levels that will about keep pace with inflation. The rates of growth for different sectors may vary, with industry likely to be favored over other performers of Federal development programs.



Trends in Federal obligations for development

SOURCE: National Science Foundation

Agencies

- In 1968 DOD and NASA alone accounted for approximately 88 percent of the development total, but in the 1978 budget three agencies—DOD, ERDA, and NASA—provided the predominant support to this type of activity—92 percent of the total.

- DOD has historically provided the largest share of support for development, accounting for 55 percent in 1968, compared with an estimated 59 percent in 1978. Although DOD has shown dollar growth in each year since 1970, with current support at an alltime high, the decline in constant dollars in the last decade is 12 percent. However, the planned increase for DOD in 1978 represented nearly three-fifths of all Federal growth in development programs. Approximately one-half of this increase can be attributed to the Navy for work on the F-18 air combat fighter, the Trident missile system, the Tomahawk missile system, V/STOL aircraft development, and the LAMPS helicopter, among the major programs. Next is the Air Force, accounting for most of the rest of the DOD development increase. Major Air Force development programs include the B-1 bomber, the F-16 air combat fighter, the M-X intercontinental ballistic missile, the ALCM air-launched cruise missile, and efforts on the space shuttle. The major Army efforts include the SAM-D Patriot missile system, the AAH advanced attack helicopter, the XM-1 tank, and the ballistic missile defense (BMD) systems technology program as well as the BMD advanced technology program.

- In the 1975-78 period ERDA showed a large increase for development activities, which more than doubled in those years. The 1978 estimated dollar increase was second only to that of DOD. Between 1968 and 1978 ERDA is the only major support agency to reflect a constant-dollar gain—79 percent. The ERDA share of the Federal development total has increased rapidly, from 9 percent in 1974 (and most prior years) to approximately 19 percent in 1978. ERDA development programs are diverse, covering the LMFBR, work on petroleum and natural gas, oil shale and in situ technology, solar energy, goethermal energy, conservation R&D activities, fusion power, fuel cycle work, nuclear development, safety facilities, nuclear materials security and safeguards, naval reactor work, uranium enrichment activities, and weapons R&D testing.

Federal obligations for development by agency

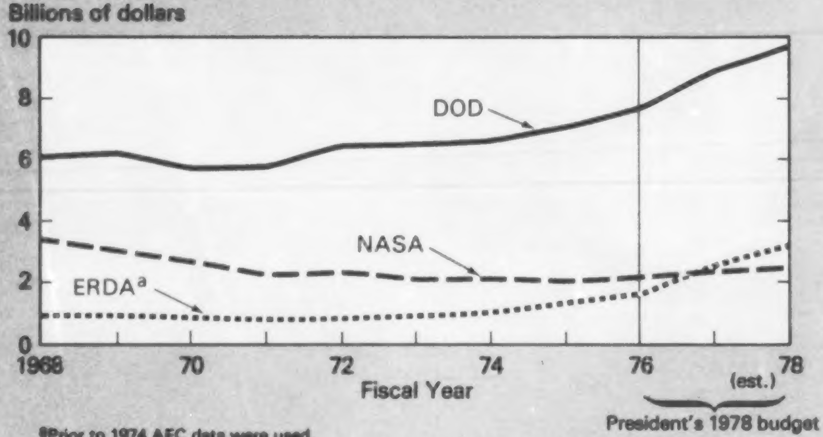
[Dollars in millions]

Agency	Actual			Estimates			
	1968	1976	Average annual percent change 1968-76	1977	Percent change 1976-77	1978	Percent change 1977-78
Total	$11,060	$12,885	+1.9	$15,612	+21.2	$16,826	+7.8
Department of Defense	6,132	7,867	+3.2	9,220	+17.2	9,930	+7.7
Energy Research and Development Administration[1]	967	1,752	+7.7	2,730	+55.8	3,170	+16.1
National Aeronautics and Space Administration	3,573	2,224	-5.7	2,300	+3.4	2,421	+5.3
Department of Health, Education, and Welfare	105	383	+17.6	529	+38.1	521	-1.5
Department of Transportation	120	263	+10.3	361	+37.3	362	+.3
Environmental Protection Agency	—	104	—	147	+41.3	127	-13.6
Other agencies	163	292	+7.6	325	+11.3	295	-9.2

[1] Atomic Energy Commission prior to 1974.

SOURCE: National Science Foundation

Trends in Federal obligations for development by agency



[a]Prior to 1974 AEC data were used.

SOURCE: National Science Foundation

- After 1968 NASA support for development decreased almost steadily until the 1976-78 period when moderate gains were shown each year for work on the space shuttle, space transportation system operations capability, and on tracking and data acqusition. The 1978 development total is still well below the 1968 level—67 percent less in constant dollars. The NASA share of the Federal development total was 32 percent in 1968 compared with an estimated 14 percent in 1978.

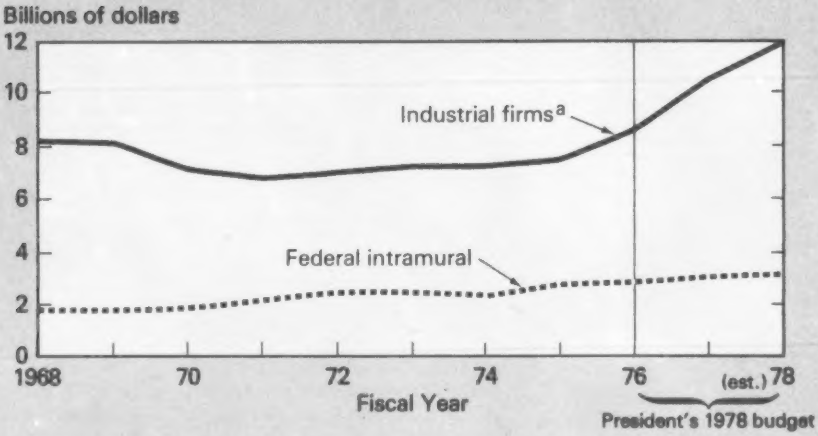
- Although growth in development work has been shown by HEW, the Department of Transportation (DOT) and EPA, these agencies still make up small portions of the Federal development total—HEW 3 percent in the 1978 budget estimate, DOT 2 percent and EPA less than 1 percent. Within HEW most development activities are sponsored by the National Institutes of Health and the Office of Education and within DOT by the Federal Aviation Administration.

Performers

- Industrial firms have been the major performers of development work throughout the 1968-78 decade, accounting in each year for well over one-half the Federal development total. However, the level of support for this sector remained below the 1968 amount until 1976 when increased funding on the part of DOD, ERDA, and NASA moved the obligation level to a high point surpassed only in 1967. The declining trend after 1967 had been attributable to the combination of a decline in NASA support of the Apollo program and a no-growth situation in DOD's weapons systems activities in most years. But by 1976 funding for the NASA space shuttle had begun to expand significantly at the same time that DOD advanced technology development increased and ERDA programs in energy development gained added momentum.

  In the next two years—1977 and 1978—DOD and ERDA contract awards to industry (and industry-administered FFRDC's) for development continued to grow rapidly, and those of NASA moderately. Greatest relative growth was shown by ERDA, but in each year DOD accounted for more than one-half the growth. In 1977, for the first time, ERDA became the agency second to DOD in the use of the industrial sector for development work. The industry share of the Federal development total—75 percent in 1968—declined to 64 percent by 1975 but was an estimated 71 percent in the 1978 budget.

Trends in Federal obligations for development by major performer



[a] Includes federally funded research and development centers (FFRDC's) administered by industrial firms.

SOURCE: National Science Foundation

It can be assumed that the upward trend in the use of industry for development will continue for the next few years, perhaps until 1980 or 1981, but at lower rates of increase. This assumption is based on the established position of the large DOD and ERDA programs mentioned earlier in this section. Some shifts may occur in DOD program emphases, but the overall development effort of this agency is based on carefully determined strategies. As for ERDA, even though work on the LMFBR has been curtailed, this program can be expected to represent a significant effort in the near future, and other ERDA programs can be expected to show continued growth. At the same time, the pace of increase in development of the NASA space shuttle is slowing down and is unlikely to be made up by the anticipated increases in work on space transportation systems (STS) operations capability development. However, as the new 2.4-meter space telescope and the Jupiter orbiter/probe enter development stages, overall NASA development levels may be sustained.

Thus, the larger companies in aircraft and missiles, in electrical equipment and communications, in machinery, and in chemicals can expect moderate R&D growth in the near-term, or at least no decline. Employment of R&D scientists and engineers may rise somewhat, although not to the levels experienced in the late sixties. In constant dollars the use of industry for development by Federal agencies has declined an estimated 21 percent between 1968 and 1978.

- The intramural sector has always been second in performance of development work for Federal agencies. Support for this sector has fluctuated throughout the 1968-78 period but has shown a fundamental rise. Intramural performance accounted for an estimated 17 percent of the Federal development total in 1968 and had risen to 22 percent by 1976, but was expected to fall to 19 percent in 1978. DOD, the largest support agency, has shown increased support for intramural performance in the past decade at the same time that NASA support has decreased in an absolute sense. NASA, however, shows moderate growth in the use of this sector in the current (1976-78) period.

- FFRDC's administered by universities have made up the third largest performance sector for development work in most years of the 1968-78 decade. Their share of the Federal development total in 1968 was 4 percent and an estimated 3 percent in the 1978 budget estimates. ERDA has always accounted for most support to this group, followed by DOD.

- The remaining performing sectors—other nonprofit institutions, universities and colleges, State and local governments, and foreign—accounted for an estimated 6 percent of the development total in the 1978 estimate, up from 5 percent in 1968. Much of the increase can be attributed to increased support by HEW to nonprofit institutions and to State and local governments.

Federal obligations for development by performer

[Dollars in millions]

Performer	Actual			Estimates			
	1968	1976	Average annual percent change 1968-76	1977	Percent change 1976-77	1978	Percent change 1977-78
Total	$11,060	$12,885	+1.9	$15,612	+21.2	$16,826	+7.8
Federal intramural	1,943	2,842	+4.9	3,305	+16.3	3,250	-1.7
Industrial firms[1]	8,292	8,717	+.6	10,686	+22.6	12,009	+12.4
Universities and colleges	150	258	+7.0	306	+18.6	341	+11.4
FFRDC's administered by universities	335	512	+5.4	563	+10.0	557	-1.1
Other nonprofit institutions[1]	320	423	+3.5	472	+11.6	416	-11.9
Other performers	21	133	+26.0	280	+110.5	254	-9.3

[1] Includes federally funded research and development centers administered by this sector.

SOURCE: National Science Foundation

Section 6. GEOGRAPHIC DISTRIBUTION, 1

For 1976, Federal R&D obligations of $20.3 billion were reported by 10 participating agencies, representing more than 97 percent of the Federal R&D effort. These agencies also reported $799 million for R&D plant.

Data are reported on a prime contract basis, although additional data were obtained from NASA on the effects of first-tier subcontracting in 1976[8]. Indications from the NASA data are that if subcontracting is taken into account, the dispersion of funds is greater than the pattern shown in the following pages.

Synopsis

- In 1976 every State and the District of Columbia[9] received Federal R&D support. California received the largest amount—$5.5 billion, and South Dakota received the smallest amount—$6.8 million.

- Four States—California, Maryland, Massachusetts, and New York—each reflected more than $1 billion in Federal R&D support in 1976.

- Seven States and the District of Columbia were recipients of Federal R&D funds in the $500 million-to-$1 billion category.

- Fifteen States received from $100 million to $500 million in Federal funds for R&D activities in 1976.

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[8] See National Aeronautics and Space Administration, Office of Procurement, *Annual Procurement Report, Fiscal Year 1976* (Washington, D.C. 20546).

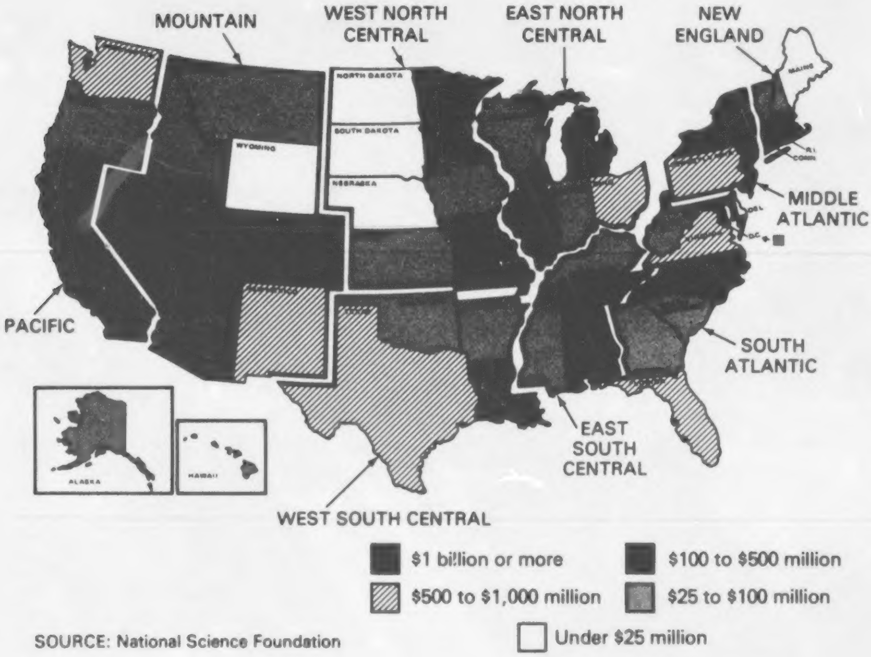
[9] In analyses of the geographic distribution of Federal R&D obligations the District of Columbia is considered a State.

976

- Eighteen States reflected support levels between $25 million and $100 million, and the six remaining States received less than $25 million.

- In 1976 a total of 41 States received larger amounts of support than in 1975. Nine States and the District of Columbia showed decreases. In 1975 increases were received by 39 States and the District of Columbia.

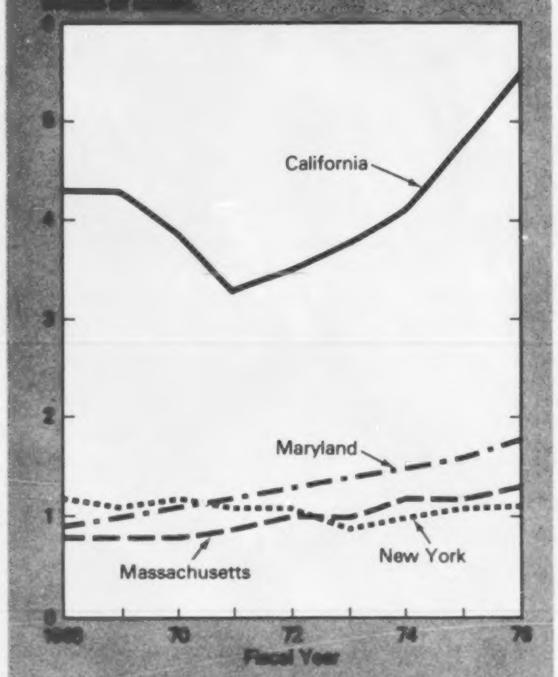
Distribution of total Federal R&D obligations by State: FY 1976


MOUNTAIN
WEST NORTH CENTRAL
EAST NORTH CENTRAL
NEW ENGLAND
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
WYOMING
MAINE
R.I.
CONN.
MIDDLE ATLANTIC
DEL.
D.C.
PACIFIC
SOUTH ATLANTIC
EAST SOUTH CENTRAL
WEST SOUTH CENTRAL
ALASKA
HAWAII
$1 billion or more
$100 to $500 million
$500 to $1,000 million
$25 to $100 million
Under $25 million

SOURCE: National Science Foundation

Trends in the Leading States

For a number of years certain States have posssed capabilities that continue to attract Federal R&D support year after year. First among these is California, which has never received a share of the Federal R&D total less than 21 percent. In this State the highly concentrated industrial skills and facilities in aircraft, aerodynamics, and related industries combined with long-established Federal intramural installations and university research strength have produced an unusual environment for the accomplishment of Federal R&D projects on the part of all agencies, espcially DOD and NASA.

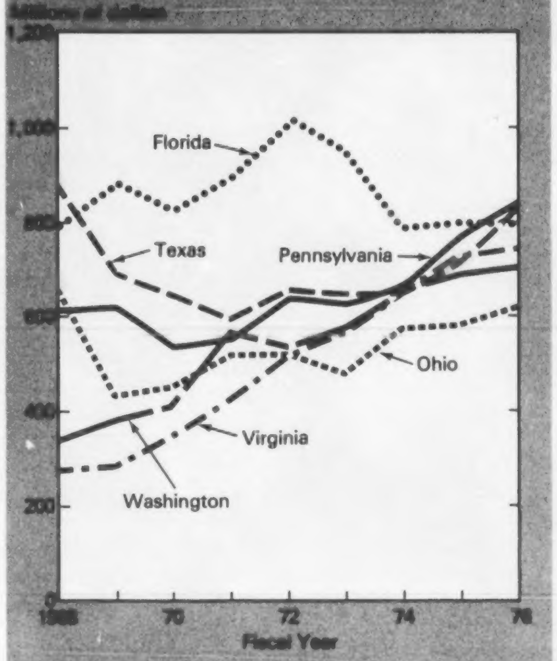


Trends in Federal R&D obligations to California, Maryland, Massachusetts, and New York:[a] FY 1968-76

[a]States that ranked 1st through 4th in Federal R&D obligations in 1976.
SOURCE: National Science Foundation

Second-ranking States have been New York from 1963 to 1970 and Maryland from 1971 to 1976. At no time, however, has either of these States received more than 9 percent of total Federal R&D support. The broader pattern shows 14 States that have been among the leading 10 in receipt of Federal R&D obligations in all the years surveyed. The criterion for leadership is not, of course, necessarily confined to the 10 most heavily funded States. The leading States might better be regarded as those with support levels above a determined-upon amount; for example, at least $375 million in 1965 and at least $625 million in 1976 in constant (1972) dollars (these amounts being roughly equivalent). Thus, 15 States in one year might be the leaders, and in another year, 13 States. But for purposes of analysis most comparisons have been made on the basis of the "leading 10" since over the years the States in this group include the States that would appear in any case in the areas above logical cutoff points.

States that have always been among the leading 10 are California, New York, Maryland, Massachusetts, Texas, Pennsylvania, and Florida. The remaining seven "leaders" that have sometimes been among the top 10 are Virginia, Washington, Ohio, New Mexico, the District of Columbia, New Jersey, and Missouri. There is a constancy in the pattern of use. Year after year the leading 10 States have accounted for approximately seven-tenths of the Federal R&D total. Carrying the analysis further, the leading 20 States in Federal R&D support from 1963 to 1976 have been made up of no more than 25 States, and the leading 20 States have accounted for approximately nine-tenths of the Federal R&D total.



Trends in Federal R&D obligations to Pennsylvania, Texas, Florida, Virginia, Washington and Ohio:[a] FY 1968-76

[a]States that ranked 5th through 10th in Federal R&D obligations in 1976.
SOURCE: National Science Foundation

Agency Support

Because of the size of their R&D efforts, DOD, NASA, HEW, and ERDA have had the major influence on the distribution of R&D funds to the various States. The leading 10 States in 1976, for example, all received more funds from DOD than from any other agency. Among the five States with the most rapid Federal R&D growth rates between 1963 and 1976 four—Virginia, Maryland, Massachusetts, and Florida—can attribute much of their growth to continuous and increasing support by DOD. The fifth State, Tennessee, reflects the growth of ERDA programs. Conversely, the low 1.5-percent average annual growth rate for New Jersey in the 1963-76 period can be ascribed to a reduction in the combined obligations of DOD and NASA in the 1971-73 years that has not been made up since then.

During the whole 1963-76 period California, Texas, Florida, Alabama, Missouri, Ohio, New York, and Maryland received substantial support from NASA. The influence of this agency has been so pervasive that the rise and fall of its major programs, such as the Apollo and Viking missions and the space shuttle, have impacted measurably upon the States. Thus, between 1963 and 1971 the average annual growth rate for Missouri was 12.3 percent, one ot the highest of any of the States. In 1965 Missouri received three-fourths of its support from NASA, but by 1968 DOD was providing the most support. In 1971, however, the NASA Skylab program was in full development through contracts with industry in Missouri. In 1974, with the work nearly completed, Missouri showed a large drop in Federal R&D support. Missouri had received one-fifth to one-third of its support from NASA in the 1968-73 period, and most of the rest from DOD, and the termination of the NASA work is reflected in the 7.6-percent rate of decline in Federal R&D funding for Missouri between 1971 and 1976. This State has been somewhat unusual among leading States in its heavy dependence on two agencies.

Colorado was also influenced by NASA programs. There, funding rose in the 1963-71 years, largely from NASA, and fell in the 1971-76 period. The decline rate of 1.3 percent between 1971 and 1976, however, disguises the impact of the NASA Viking Lander program on industry contracts in Colorado from 1972 to 1974. Other States with decline rates or virtually no growth in the later (1971-76) period are Florida, New York, and Alabama, and again the reduction of NASA funding has been the chief influence. In the earlier period (1963-71) the growth rates for these States were strongly determined by NASA, although DOD was also important in New York and Florida.

Average annual rates of change in Federal R&D obligations to selected States[1] for fiscal years 1963-76, 1963-71, and 1971-76

States[2]	1963-76	1963-71	1971-76
United States, total	3.9	2.8	5.9
California	1.9	-3.2	10.8
Maryland	7.9	7.5	8.5
Massachusetts	7.3	7.0	7.7
New York	1.2	2.2	-.2
Pennsylvania	5.2	3.0	8.8
Texas	5.9	5.2	7.0
Florida	6.7	12.7	-2.4
Virginia	12.7	13.1	12.1
Washington	6.0	7.1	4.3
Ohio	5.7	6.9	3.9
New Mexico	4.7	3.6	5.2
District of Columbia	2.7	2.1	3.6
New Jersey	1.5	7.8	-7.8
Tennessee	7.9	3.3	17.5
Illinois	5.6	2.5	10.7
Missouri	4.2	12.3	-7.6
Alabama	3.3	4.8	.8
Colorado	.2	1.2	-1.3
Connecticut	4.3	.9	9.8
Michigan	2.8	2.4	3.4
Nevada	2.6	2.7	2.4
Louisiana	-3.1	-8.8	6.9
Arizona	-2.7	-8.1	6.5

[1] States selected represent the 20 leading States in total Federal R&D support in FY 1963, 1971, and 1976.

[2] States are listed in descending order of size of Federal R&D funding in 1976.

SOURCE: National Science Foundation

Growth in the 1971-76 period can be attributed to NASA in the case of California, where industry has received substantial support for the space shuttle program, and also to DOD for work on the B-1 bomber, among other programs. Thus, the California average annual growth rate of 10.8 percent in the later period is one of the highest of all agencies, whereas in the 1963-71 period the 3.2-percent rate of decline for California was attributable in large part to a reduction in NASA support after 1969.

Other States with high growth rates between 1971 and 1976 are Tennessee, Virginia, and Illinois, and they were strongly influenced by ERDA energy R&D programs. ERDA programs have also contributed to the high California growth rate in this period and to increased rates for Pennsylvania and New Mexico. In the case of Virginia, however, DOD has had more influence than ERDA.

Although HEW, NSF, and the other agencies have not been mentioned, they have also tended to place more of their R&D support in the leading 10 or 20 States, thus contributing to the leadership status of these States. Generally speaking, these States offer a variety of skills and organizational competence to meet the special R&D needs of different agencies. A few States among the leaders, usually those used mainly for energy and weapons work, offer a narrower range of capabilities but are still highly important in their adaptability to certain R&D tasks.

States Leading in 1976

California received the largest share of the Federal R&D total in 1976 with nearly $5.5 billion, or 27 percent. An increase of $656 million for California in 1976 is attributable to large increases by NASA, DOD, and ERDA, and smaller increases by most other agencies. DOD provided more than one-half the total funds for California in 1976 while NASA provided more than one-fourth and ERDA nearly one-tenth. Industrial firms received the largest share (69 percent) of all Federal agency support to the State with DOD responsible for almost two-thirds—chiefly for work on the B-1 bomber, the Trident I missile system, and ballistic missile site defense. NASA was responsible for almost all the rest of the industrial total, covering work on the space shuttle vehicle, overall planning and integration of all elements of the space shuttle program, the Pioneer Venus spacecraft, the Delta space vehicles, and the High Energy Astronomy Observatories. Federal intramural installations accounted for 14 percent of the California total with DOD the prime support agency. DOD facilities include the Naval Electronics Laboratory, the Naval Weapons Center, the Pacific Missile Test Center (Navy), and the Space and Missile Test Center (Air Force). All the other agencies also reported intramural performance in California in 1976. NASA facilities include the Flight Research Center and the Ames Research Center. In 1976 universities and colleges accounted for 7 percent of the California total. HEW provided most funds to this sector—one-half of the total. DOD, however, showed the largest increase. FFRDC's administered by universities accounted for 6 percent of the California total. Nearly three-fourths of the funds were provided by ERDA for work at the E. O. Lawrence Berkeley and the E. O. Lawrence Livermore Laboratories, and the Stanford Linear Accelerator Center. Nonprofit institutions showed a slight drop in 1976 and made up 4 percent of the total (including FFRDC's).

Maryland in 1976 received an increase of $201 million. The Maryland total was $1.8 billion, or nearly 9 percent of the Federal R&D total. Most agencies showed increased support. DOD accounted for 43 percent of the Maryland total, HEW for 30 percent, and NASA for 16 percent. The intramural sector, always the leading one in this State, showed another increase, keeping this sector at almost two-thirds of all performance. Federal R&D facilities in Maryland include the National Institutes of Health (HEW), the Edgewood Arsenal Laboratories (Army), the Naval Air Test Center, the Naval Surface Weapons Center, the Goddard Space Flight Center (NASA), the Agricultural Research Center (USDA), and the National Bureau of Standards (Commerce). In 1976 industrial firms showed the largest relative increase among all sectors and accounted for 27 percent of total performance, largely under the sponsorship of DOD, NASA, and HEW. Most of the HEW support is directed to the Federick Cancer Research Center, an FFRDC administered by industry. Universities and colleges in Maryland in 1976 showed moderate growth and accounted for 4 percent of all performance; they were chiefly supported by HEW.

Massachusetts R&D funding from Federal agencies grew $56 million in 1976 and accounted for 6 percent of the Federal R&D total or $1.3 billion. DOD provided the largest share of support, 70 percent, and HEW provided 14 percent. DOD, HEW, NASA, and ERDA were responsible for much of the overall increase for this State in 1976. Industrial firms represented nearly one-half of all performance with almost all of this support furnished by DOD. Major DOD projects included the utility tactical transport aircraft system (UTTAS), the HAWK, and the A-10 aircraft. Federal R&D support to Massachusetts universities and colleges grew in 1976 and accounted for 17 percent of the State total. Federal support for intramural performance dropped in 1976, largely from actions of DOD, the chief support agency. The 1976 intramural share of the State R&D total was 15 percent. FFRDC's administered by universities also showed a decrease in support in 1976, attributable to the Air Force for work at the Lincoln Laboratory. Nonprofit institutions, 14 percent of the total, showed a slight increase, brought about by substantially increased support by HEW.

Distribution of Federal R&D obligations to the 10 States leading in such support in FY 1976 for selected years

[Dollars in millions]

State	1965	1971	1975	1976
Total, all States	$14,357	$15,240	$18,549	$20,255
	Percent distribution			
California	31.7%	21.6%	26.1%	27.1%
Maryland	6.1	7.9	8.7	8.9
Massachusetts	5.1	5.8	6.6	6.3
New York	9.0	7.3	5.7	5.5
Pennsylvania	3.7	3.6	4.2	4.1
Texas	5.1	3.9	3.8	4.1
Florida	3.2	5.8	4.3	3.9
Virginia	2.0	2.8	3.9	3.7
Washington	1.5	3.7	3.7	3.5
Ohio	2.6	3.4	3.2	3.1
All other States[1]	30.0	34.2	29.8	29.8

[1] Includes outlying areas and offices abroad.

SOURCE: National Science Foundation

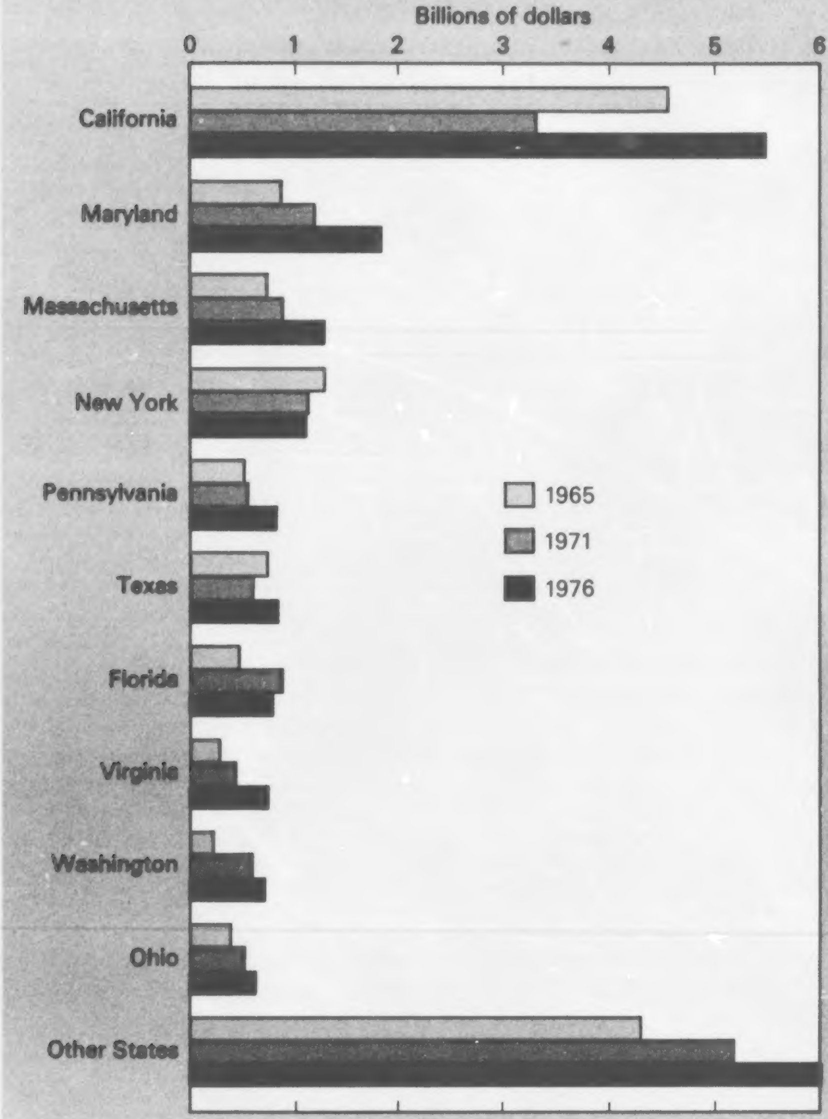
The **New York** increase of $49 million in 1976 raised that State's total to $1.1 billion, or 5 percent of all Federal R&D support. New York receives most of its support from DOD, HEW, ERDA, NSF, and NASA. Awards to industrial firms accounted for 50 percent of the total Federal R&D support in 1976, while support to universities and colleges accounted for 25 percent. Over the 1968-76 period the industrial share declined as NASA funding dropped off steeply and DOD funding also fell. In recent years HEW has stepped up support to the university sector. In 1976 support to intramural performance represented 8 percent of the Federal R&D total. This was chiefly influenced by DOD.

The **Pennsylvania** increase of $55 million from Federal agencies in 1976 placed it fifth among all States in Federal R&D support with $836 million, or 4 percent of the R&D total. DOD, ERDA, and HEW were the leading R&D sponsors. Industrial firms (including FFRDC's) accounted for approximately three-fifths of all performance, with ERDA the primary source of funds. Nearly one-half of the support was directed to the Bettis Atomic Laboratory, an industry-administered FFRDC. Intramural performance accounted for 19 percent of the total Federal R&D support to Pennsylvania in 1976. Most of this activity was accounted for by DOD whose facilities include the Frankford Arsenal Laboratories (Army), and the Naval Air Development Center. Interior contributed to the intramural total chiefly for demonstrations conducted by the Bureau of the Mines. Federal R&D support to universities and colleges made up 15 percent of the Federal R&D total to the State, with most work sponsored by HEW.

Texas showed an increase of $122 million in 1976, raising the level of support to $836 million, or 4 percent of the Federal R&D total. In 1976 DOD increased support significantly to industrial firms, thereby affecting the total, since more than one-half the Federal R&D funds for Texas were awarded to industry. Work for DOD covered the sea-launched cruise missile, among other projects. NASA was the second agency in size of support to industry, and work for NASA included systems support services. More than one-fourth of all Federal R&D performance was intramural, and most of this represented NASA support for the Johnson Space Flight Center. A large increase in 1976 reflected space shuttle activities. Support to Texas universities and colleges represented 15 percent of the Federal R&D total in 1976, and most of this support was provided by HEW.

A decrease for **Florida** of nearly $9 million in Federal R&D support in 1976 placed the R&D total at $788 million, or slightly less than 4 percent of all Federal R&D support to the States. Much of the decrease was attributable to DOD in the intramural sector. Federal intramural performance, chiefly supported by DOD and NASA, makes up more than one-half of all performance. Industrial performance, approximately two-fifths of all support, also mainly depends on DOD and NASA. Among the more important Federal R&D facilities in the State are the Naval Coastal Systems Laboratory and the Air Force Eastern Test Range, both under DOD, as well as the

Federal R&D support to the 10 states leading in such support in 1976 for selected years



SOURCE: National Science Foundation

Federal R&D obligations by geographic division and State for selected years

[Dollars in millions]

Division and State	1965	1971	1975	Net increase/ decrease 1965-75	1976	Net increase/ decrease 1975-76
Total, all States	$14,356.8	$15,194.2	$18,472.2	+$4,115.4	$20,190.6	+$1,718.4
Pacific	4,849.0	4,004.9	5,687.8	+ 838.8	6,363.8	+ 676.0
Alaska	14.4	58.2	34.5	+ 20.1	35.4	+ .9
California	4,553.3	3,296.4	4,837.6	+ 284.3	5,493.7	+ 656.1
Hawaii	41.5	38.3	43.0	+ 1.5	45.5	+ 2.5
Oregon	25.6	41.9	78.5	+ 52.1	84.1	+ 5.6
Washington	214.3	571.2	694.2	+ 479.9	705.1	+ 10.9
South Atlantic	2,154.9	3,224.6	3,989.8	+1,834.9	4,224.9	+ 235.1
Delaware	7.1	13.0	10.0	+ 2.9	7.9	- 2.1
District of Columbia	374.3	478.2	579.8	+ 205.5	570.2	- 9.6
Florida	459.8	890.4	796.8	+ 337.0	788.1	- 8.7
Georgia	58.4	78.8	80.8	+ 22.4	91.9	+ 11.1
Maryland	876.6	1,201.2	1,609.3	+ 732.7	1,810.1	+ 200.8
North Carolina	57.8	82.7	116.9	+ 59.1	139.1	+ 22.2
South Carolina	17.1	23.4	24.5	+ 7.4	30.7	+ 6.2
Virginia	284.2	424.9	726.0	+ 441.8	750.6	+ 24.6
West Virginia	19.6	32.1	45.7	+ 26.1	36.4	- 9.3
Middle Atlantic	2,228.6	2,413.5	2,280.0	+ 51.4	2,437.6	+ 157.6
New Jersey	410.7	745.1	441.9	+ 31.2	495.6	+ 53.7
New York	1,289.3	1,119.5	1,057.4	- 231.9	1,106.1	+ 48.7
Pennsylvania	528.7	548.9	780.7	+ 252.0	836.0	+ 55.3
New England	992.7	1,148.8	1,649.5	+ 656.8	1,715.5	+ 66.0
Connecticut	184.5	149.9	269.6	+ 85.1	239.4	- 30.2
Maine	4.3	13.6	11.4	+ 7.1	15.3	+ 3.9
Massachusetts	733.7	887.0	1,228.6	+ 494.9	1,284.9	+ 56.3
New Hampshire	28.8	34.0	33.5	+ 4.7	34.6	+ 1.1
Rhode Island	37.5	50.5	75.0	+ 37.5	101.6	+ 26.6
Vermont	4.0	13.7	31.4	+ 27.4	39.5	+ 8.1
East North Central	923.7	1,121.7	1,375.4	+ 451.7	1,437.3	+ 61.9
Illinois	191.7	249.1	371.1	+ 179.4	414.0	+ 42.9
Indiana	71.9	74.6	92.7	+ 20.8	92.3	- .4
Michigan	155.2	187.3	247.8	+ 92.6	221.0	- 26.8
Ohio	379.1	518.1	548.8	+ 205.7	627.4	+ 42.6
Wisconsin	125.8	92.6	79.0	- 46.8	82.5	+ 3.5
Mountain	990.1	1,127.4	1,274.2	+ 284.1	1,392.8	+ 118.6
Arizona	76.6	88.7	115.7	+ 39.1	121.8	+ 6.1
Colorado	212.3	264.2	266.6	+ 54.3	247.1	- 19.5
Idaho	63.6	75.3	66.3	+ 2.7	71.7	+ 5.4
Montana	8.6	17.6	26.5	+ 17.9	27.6	+ 1.1
Nevada	154.5	159.0	149.4	- 5.1	179.0	+ 29.6
New Mexico	425.3	458.7	554.3	+ 129.0	625.8	+ 71.5
Utah	45.0	55.8	79.4	+ 34.4	100.7	+ 21.3
Wyoming	4.2	8.1	16.0	+ 11.8	19.1	+ 3.1
West South Central	1,143.1	733.1	872.3	- 270.8	1,019.7	+ 147.4
Arkansas	6.6	20.8	23.3	+ 16.7	26.5	+ 3.2
Louisiana	377.1	90.1	101.7	- 235.4	125.9	+ 24.2
Oklahoma	28.4	26.3	34.2	+ 5.8	31.7	- 2.5
Texas	731.0	595.9	713.1	- 17.9	835.6	+ 122.5
East South Central	628.3	618.2	770.4	+ 142.1	919.5	+ 149.1
Alabama	370.7	360.0	363.6	- 7.1	374.4	+ 10.8
Kentucky	17.1	23.0	34.9	+ 17.8	50.7	+ 15.8
Mississippi	36.7	46.7	57.7	+ 21.0	71.4	+ 13.7
Tennessee	203.7	188.5	314.2	+ 110.5	423.0	+ 108.8
West North Central	408.7	786.0	571.2	+ 162.5	678.2	+ 107.0
Iowa	28.8	32.9	47.3	+ 18.5	47.9	+ .6
Kansas	25.7	24.3	32.8	+ 7.1	32.0	- .8
Minnesota	106.3	102.8	123.0	+ 16.7	153.0	+ 30.0
Missouri	231.7	596.9	329.1	+ 97.4	403.3	+ 74.2
Nebraska	7.7	10.4	20.0	+ 12.3	21.0	+ 1.0
North Dakota	5.0	9.1	12.6	+ 7.6	14.3	+ 1.7
South Dakota	3.5	9.6	6.4	+ 2.9	6.8	+ .4
Outlying areas	9.2	5.2	.5	- 8.7	.3	- .2
Offices abroad	28.5	10.8	1.1	- 27.4	1.0	- .1

SOURCE: National Science Foundation

Kennedy Space Center at Cape Canavaral, under NASA. Although NASA decreased support to industry in 1976, it increased intramural performance at the space center mostly for activities connected with the space shuttle. The slight increase given by DOD to industry included work on the Pershing and Patriot SAM-D missile systems. R&D support by Federal agencies to Florida universities and colleges in 1976 was 6 percent of the total, mainly derived from HEW.

Virginia received a $25 million increase to $751 million and accounted for nearly 4 percent of the Federal R&D total. DOD continued to provide the largest share of Federal support. NASA increased support in 1976 and accounted for the next largest share. ERDA showed the largest dollar gain although HEW and DOT were next in size of support. Intramural performance in Virginia has over the years led all other kinds. In 1976 intramural performance accounted for 48 percent of the Federal R&D total, and DOD and NASA were the chief sponsors. Industrial performance, 40 percent of the total in 1976, has been increasing significantly, with ERDA currently a growing agency sponsor. Although DOD and NASA use industry for R&D efforts far more, HEW and ERDA have been turning to industry recently. In 1976 universities and colleges represented 5 percent of all Federal R&D funding in Virginia, as did nonprofit institutions (excluding FFRDC's).

The **Washington** R&D total from Federal agencies in 1976 was $705 million, an increase of $11 million over 1975, and 4 percent of all Federal R&D obligations. DOD and ERDA were the chief sponsors, accounting jointly for four-fifths of the funds. HEW accounted for less than one-tenth. Industrial firms were the primary recipients of Federal R&D support, most of this from DOD, whose contracts with industry covered the work on E-4A advanced airborne command post (AABNCP), E-3A advanced warning and control system (AWACS), patrol hydrofoil missile ship, and SRAM air-to-ground ballistic missile. The ERDA share of the industrial R&D total had fallen somewhat in 1976, largely from reduced work at the Hanford Engineering Development Laboratory, an industry-administered FFRDC. Universities and colleges, the next largest sector, showed a slight drop in 1976 from lower funding. Support to nonprofit institutions was primarily represented by work at the Pacific Northwest Laboratory, a nonprofit-administered FFRDC under ERDA sponsorship. Federal intramural performance was not strongly supported by any agency.

The **Ohio** total of $627 million in 1976 reflected a $43 million increase. This State accounted for 3 percent of the Federal R&D total. Ohio receives heaviest R&D support from DOD and NASA, which focus on intramural installations and industrial firms. Intramural performance accounted for 46 percent of the Ohio total in 1976. Although DOD, the largest support agency, reduced funds, ERDA, EPA, and NASA increased their intramural activities, almost offsetting the DOD decline. Support for industrial performance acounted for 37 percent of the Ohio total. All agencies show increased support to this sector in 1976. The Captor torpedo and Condo cruise missile were among industrial R&D projects supported by DOD funds. Universities and colleges and other nonprofit institutions were primarily sponsored by HEW. ERDA reflected a large increase to the nonprofit group in 1976.

In 1976 **New Mexico** was eleventh in amount of R&D support and the **District of Columbia** was twelfth, each receiving above $500 million. For New Mexico, industrial performance made up 35 percent of the Federal R&D total followed by intramural and nonprofit performance, each 31 percent of the total. ERDA and DOD support most of the R&D activities in New Mexico. For the District of Columbia, intramural performance was by far the chief kind—73 percent of the total in 1976. DOD is the largest support agency and places most of its work in the District intramurally.

Distribution of Funds by Performers

When States are compared by performing sectors, contrasting patterns of rank are shown. Federal agencies seeking certain kinds of research or development competence to implement their missions have turned to existing organizations with specialized capabilities within given States. It can be seen that certain States have particular strength in one or two performing sectors but that a number have strength in many sectors.

Thus, Maryland accounted for 21 percent of all Federal *intramural* work in 1976 and California for 14 percent. Despite the presence of Federal agency headquarters in the District of Columbia, this "State" accounted for only 8 percent and ranked lower than Florida, the third State, also with 8 percent.

In the use of *industrial firms* (including FFRDC's) California represented 37 percent of the national total of Federal R&D contract awards, and the second place State—Massachusetts—accounted for 6 percent. Washington and New York each accounted for between 5 percent and 6 percent. Although the shares were not high for these States, the amounts received were larger than the amount any State received for university-performed R&D work in 1976. The leading 10 States accounted for 78 percent of the industry total.

California led again in Federal R&D awards to *universities and colleges* in 1976 with 15 percent of the total. New York, however, represented 11 percent and Massachusetts, 9 percent. This sector shows the widest dispersion of funds among States in that the leading 10 States accounted for only 62 percent of total funds whereas in all other sectors the 10 leading States accounted for a considerably larger share.

As to *university-administered FFRDC's* 34 percent of the funds in 1976 were directed to organizations of this nature located in California. The next ranking State was New Mexico with 18 percent of the sectoral total. The tenth State—Pennsylvania—had 1 percent.

California again was the chief recipient of Federal R&D support in the case of *other nonprofit institutions* (including FFRDC's)--with 23 percent of the total. Next was Massachusetts with 21 percent followed by New York with 9 percent. These institutions tend to be found in States with university R&D strength.

Federal R&D obligations to each performing sector in the 10 States leading in support to that sector; FY 1976

[Dollars in millions]

Federal intramural		Industrial firms[1]		Universities and colleges		FFRDC's administered by universities		Other nonprofit institutions[1]	
Total	$5,512	Total	$10,162	Total	$2,498	Total	$1,049	Total	$ 843
Maryland	1,157	California	3,765	California	383	California	356	California	194
California	766	Massachusetts	619	New York	277	New Mexico	187	Massachusetts	177
Florida	422	Washington	559	Massachusetts	223	Illinois	166	New York	76
District of Columbia	417	New York	557	Pennsylvania	128	New York	84	Washington	47
Virginia	364	Pennsylvania	490	Texas	125	Maryland	72	Virginia	47
Ohio	290	Maryland	486	Illinois	122	Massachusetts	62	Pennsylvania	42
Alabama	243	Texas	452	Maryland	79	New Jersey	31	District of Columbia	38
Texas	239	Tennessee	349	Michigan	69	Colorado	23	Ohio	38
Massachusetts	196	Missouri	314	North Carolina	69	Idaho	21	Illinois	28
New Mexico	195	Florida	308	Washington	64	Pennsylvania	11	Minnesota	16
All other States[2]	1,226	All other States[2]	2,263	All other States[2]	969	All other States[2]	36	All other States[2]	140

[1] Includes federally funded research and development centers administered by this sector.

[2] Includes outlying areas and offices abroad.

SOURCE: National Science Foundation

R&D Plant

- Among the 10 leading States to receive Federal R&D plant support in 1976, five were among the top 10 in Federal R&D obligations.
- Since 1968, 17 States have been among the 10 leading States in R&D plant support. California, New York, Florida, Maryland, New Mexico, and Illinois have always been among the leading 10, and in 1976, New Jersey appeared among the leading 10 for the first time.
- In 1976 California received the largest amount of support for R&D plant for the sixth consecutive year. Washington ranked second for the third consecutive year. However, California, Washington, Florida, New York, and Maryland received less support for R&D plant in 1976 than in 1975.
- The largest relative increase was for the District of Columbia, attributable chiefly to NSF for the purchase of airplanes for use in research in the Antarctic. New Jersey showed a large increase attributable to ERDA and DOD. Tennessee, Illinois, and New Mexico showed increases resulting from ERDA programs.
- In 1976 ERDA provided the most funds for R&D plant and was the largest support agency for seven of the 10 leading States: California, Washington, New Mexico, Tennessee, Illinois, New York, and New Jersey. DOD was the major support agency in Maryland; NASA, in Florida; and NSF in the District of Columbia.

Factors in R&D Performing Strength

R&D obligations can be ranked by State and compared with such measures of national resources as population, total personal income, total Federal taxes, and doctoral scientists and engineers. Although no direct cause-and-effect relationships can be inferred, the data tend to indicate that the more populous and wealth-producing areas contain the larger concentrations of doctoral scientists and engineers and are in an advantageous position for various reasons to meet the R&D requirements of Federal agencies.

Federal obligations for R&D plant in the 10 States leading in such support by agency: FY 1976

[Dollars in millions]

	Total	ERDA	DOD	NASA	NSF	HEW	USDA	DOT	Other[1]
Total	$799	$439	$143	$82	$53	$33	$16	$14	$19
California	147	71	52	12	1	—	(2)	6	4
Washington	103	101	(2)	—	(2)	2	(2)	—	(2)
New Mexico	77	69	8	—	—	—	(2)	—	—
Florida	76	—	30	45	(2)	—	(2)	—	1
Tennessee	61	59	1	—	(2)	—	—	—	—
Illinois	45	35	3	—	1	1	5	—	(2)
New York	38	27	1	1	1	5	(2)	—	2
Maryland	37	1	15	2	(2)	13	4	1	(2)
New Jersey	22	17	3	(2)	(2)	—	—	1	(2)
District of Columbia	21	(2)	2	1	18	—	(2)	—	—
All other States[3]	172	59	28	21	32	12	7	6	12

[1] Includes the Departments of Commerce, Interior, and the Environmental Protection Agency.

[2] Less than $500,000.

[3] Includes outlying areas and offices abroad.

SOURCE: National Science Foundation

Distribution of Federal R&D obligations compared with other national indicators by State; FY 1976

State	Total Federal R&D obligations		Population		Total personal income		Total Federal taxes[2]		Doctoral scientists and engineers[5]	
	Rank	Percent of total	Rank	Percent of total	Rank	Percent of total	Rank	Percent of total	Rank	Percent of total
United States, total	$20,255 million		[1]215 million		$1,382,457 million		$268,144 million		278 thousand	
California	1	27.12	1	10.03	1	11.15	2	8.92	1	11.48
Maryland	2	8.94	18	1.93	14	2.11	9	2.68	11	3.19
Massachusetts	3	6.34	10	2.71	10	2.77	12	2.40	6	4.36
New York	4	5.46	2	8.42	2	9.29	1	12.59	2	10.12
Pennsylvania	5	4.13	4	5.53	5	5.55	4	5.67	3	5.51
Texas	6	4.13	3	5.82	4	5.64	6	5.43	5	4.48
Florida	7	3.89	8	3.92	9	3.72	11	2.41	13	2.26
Virginia	8	3.71	13	2.34	12	2.28	18	1.63	12	2.68
Washington	9	3.48	22	1.68	18	1.77	22	1.32	20	1.71
Ohio	10	3.10	6	4.98	6	4.97	5	5.63	7	4.25
New Mexico	11	3.09	37	.54	38	.44	42	.23	26	1.11
District of Columbia	12	2.81	44	.33	39	.44	(3)	(3)	10	3.47
New Jersey	13	2.45	9	3.42	8	3.86	8	3.54	8	4.20
Tennessee	14	2.09	17	1.96	21	1.66	23	1.12	21	1.69
Illinois	15	2.04	5	5.23	3	6.04	3	7.29	4	4.67
Missouri	16	1.99	15	2.23	16	2.08	10	2.65	22	1.64
Alabama	17	1.85	21	1.71	23	1.35	27	.87	29	1.02
Colorado	18	1.22	28	1.20	26	1.22	19	1.47	17	1.84
Connecticut	19	1.18	24	1.45	20	1.66	16	1.88	18	1.82
Michigan	20	1.09	7	4.24	7	4.61	7	5.11	9	3.48
Nevada	21	.88	47	.28	44	.32	44	.21	50	.16
Minnesota	22	.76	19	1.85	19	1.76	14	2.02	19	1.73
North Carolina	23	.69	11	2.55	13	2.14	15	2.00	14	2.10
Louisiana	24	.62	20	1.79	22	1.50	25	1.06	24	1.16
Arizona	25	.60	32	1.06	31	.96	32	.51	27	1.05
Rhode Island	26	.50	39	.43	40	.44	36	.38	39	.47
Utah	27	.50	36	.57	36	.49	39	.28	32	.92
Indiana	28	.46	12	2.47	11	2.40	13	2.25	15	2.09
Georgia	29	.45	14	2.32	17	2.00	20	1.43	28	1.03
Oregon	30	.41	30	1.08	29	1.07	29	.77	23	1.63
Wisconsin	31	.41	16	2.15	15	2.10	17	1.75	16	1.88
Idaho	32	.35	41	.39	43	.34	40	.28	42	.39
Mississippi	33	.35	29	1.10	32	.78	37	.36	36	.57
Kentucky	34	.25	23	1.60	24	1.34	21	1.33	33	.89
Iowa	35	.24	25	1.34	25	1.34	26	.91	30	.96
Hawaii	36	.22	40	.41	37	.44	38	.30	41	.40
Vermont	37	.20	49	.22	51	.19	50	.10	46	.32
West Virginia	38	.18	34	.85	34	.71	35	.39	38	.49
Alaska	39	.17	51	.18	47	.28	41	.23	51	.15
New Hampshire	40	.17	42	.38	42	.36	45	.21	44	.35
Kansas	41	.16	31	1.08	28	1.09	28	.83	34	.85
Oklahoma	42	.16	27	1.29	27	1.13	24	1.11	31	.93
South Carolina	43	.15	26	1.33	31	1.06	31	.56	35	.78
Montana	44	.14	43	.35	46	.30	47	.16	45	.35
Arkansas	45	.13	33	.98	33	.77	34	.40	40	.41
Nebraska	46	.10	35	.72	35	.70	30	.71	37	.55
Wyoming	47	.09	50	.18	50	.19	49	.12	48	.20
Maine	48	.08	38	.50	41	.42	43	.23	43	.37
North Dakota	49	.07	46	.30	48	.25	46	.18	47	.23
Delaware	50	.04	48	.27	45	.31	33	.48	25	1.16
South Dakota	51	.03	45	.32	49	.24	48	.15	49	.19
Outlying areas and offices abroad	—	.32	—	—	—	—	—	[4].47	—	.27

[1] Provisional estimates of resident population as of July 1, 1976.

[2] Includes individual income and employment taxes, corporate income, excise, estate and gift taxes (minus refunds).

[3] Included in Maryland tax figures.

[4] Collections from and refunds to U.S. taxpayers in Puerto Rico, Canal Zone, and in foreign countries.

[5] 1975 data.

SOURCES: U.S. Department of Commerce, Bureau of the Census, *Current Population Reports*, Series P-25, No. 642, December 1976 and Bureau of Economic Analysis, *Survey of Current Business*, Volume 57, No. 4, April 1977; U.S. Department of the Treasury, *Statistical Appendix to Annual Report of the Secretary of the Treasury on the State of the Finances for the Fiscal Year ended June 30, 1976 and Transition Quarter;* National Science Foundation.

Part II

FEDERAL FUNDS FOR SCIENTIFIC AND TECHNICAL INFORMATION

Scientific and technical information (STI) is defined as knowledge or data resulting from the conduct of research and development, or required for organizing, administering, or performing research and development. Such information is used largely by scientists and engineers engaged in R&D work.

STI activities cover a broad range, including publication and distribution; documentation, reference and information services; symposia and audiovisual communication; and R&D work in the information sciences. This last category directly overlaps the R&D activities reported in part I of this survey.

The data on STI in *Federal Funds* surveys include only direct STI obligations of Federal agencies; STI activities under R&D contracts and grants are specifically excluded. Therefore, the totals in this report reflect only partially the STI activities supported by the Federal Government.

Despite this limitation, the broad measurement of direct STI costs of Federal agencies on a functional basis can be useful as a guide to analysis.

AGENCIES AND ACTIVITIES

- STI activities are currently growing. An estimated increase of 8 percent in the total in 1977 was expected to be followed by an estimated increase of 4 percent in 1978.
- At present the Department of Defense (DOD) accounts for more than one-fourth of all STI activities, the Department of Commerce for over one-fifth, and the Department of Health, Education, and Welfare (HEW) for just under one-fifth.

Federal obligations for scientific and technical information by agency

[Dollars in millions]

Agency	Actual	Estimates			
	1976	1977	Percent change 1976-77	1978	Percent change 1977-78
Total	$468.9	$508.1	+8.4	$529.9	+4.3
Department of Defense	132.8	137.4	+3.4	146.3	+6.5
Department of Commerce	109.2	117.5	+7.6	118.7	+1.0
Department of Health, Education, and Welfare	84.4	96.9	+14.8	102.2	+5.5
Library of Congress	34.9	37.1	+6.2	38.4	+3.6
Department of the Interior	27.0	31.4	+16.1	32.2	+2.4
National Aeronautics and Space Administration	23.2	23.7	+2.2	25.7	+8.2
Department of Agriculture	16.0	18.3	+14.6	19.1	+4.2
Other agencies	41.3	45.8	+10.9	47.3	+3.4

SOURCE: National Science Foundation

Trends

- Between 1960 and 1978 federally funded STI activities have increased almost seven times.
- In the 1978 budget obligations for STI activities are the equivalent of an estimated 2 percent of all Federal R&D obligations. The comparable ratio in 1960 was 1 percent.
- The greatest dollar growth in a category of STI activities is found in documentation, reference, and information sciences, which will represent

Trends in Federal obligations for scientific and technical information activities by major categories

[Dollars in millions]

Fiscal year	Total	Publication and distribution	Documentation, reference, and information services	Symposia and audiovisual media	R&D in information sciences, documentation and information systems, techniques and devices
1960	$75.9	$37.0	$28.4	$7.6	$2.9
1961	91.6	48.7	29.0	6.7	7.2
1962	128.5	55.7	42.4	17.0	13.3
1963	164.5	67.7	64.0	21.0	11.9
1964	[1]203.2	59.9	90.8	22.7	12.6
1965	224.7	68.2	102.0	32.0	22.5
1966	277.7	82.7	124.6	22.5	48.0
1967	324.4	87.1	152.5	31.7	53.1
1968	359.2	100.7	165.6	34.1	58.8
1969	362.5	96.0	170.9	31.8	63.7
1970	386.8	98.9	198.1	32.6	62.1
1971	397.6	106.0	193.8	32.8	65.0
1972	419.4	116.6	196.5	36.5	69.7
1973	427.1	120.9	194.8	34.1	77.3
1974	442.8	129.1	199.4	35.0	79.3
1975	398.1	123.3	179.2	23.8	71.8
1976	468.9	144.7	226.6	27.9	69.7
1977 (est.)..	508.1	155.8	253.9	29.9	68.5
1978 (est.)..	529.9	161.1	262.9	31.6	74.3

[1] Includes $17.2 million for management, which was reported separately from the other categories in 1964 only.

NOTE: Overall totals for 1975-78 and totals for some subcategories are preliminary and subject to revision as a result of incomplete reporting for those years by the Department of the Army.

SOURCE: National Science Foundation

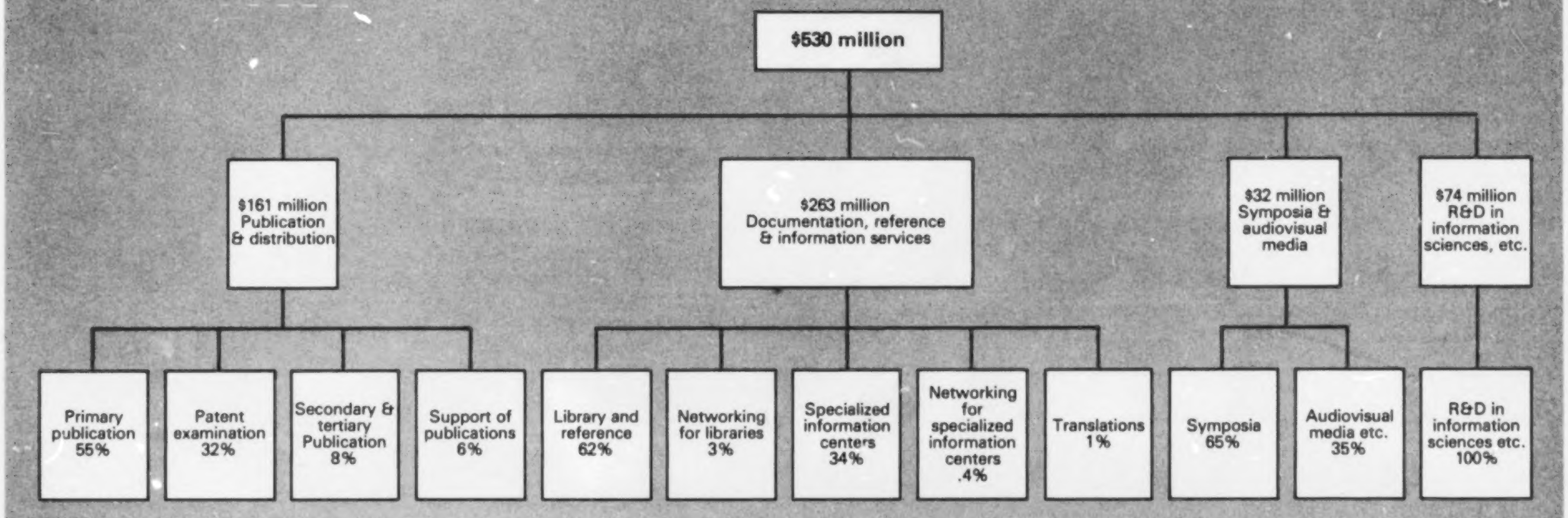
an estimated 50 percent of all STI activities in 1978. The strong growth in this category reflects the proliferation of library and specialized information center services, including high costs of modern retrieval systems. A specific subcategory for networking is now included in the survey.

- At present, publication and distribution, including patent examination, makes up the next most important STI category. This area was expected to represent 30 percent of the STI total in 1978.
- Research and development in information sciences has shown the greatest relative increase between 1960 and 1978, having grown 26 times in that period. The share of this category in the STI total is an estimated 14 percent in 1978.[10]
- Symposia and audiovisual media is expected to account for 6 percent of all STI activities in 1978.

Categories

- Major categories have been further subdivided in the present survey in order to make visible more kinds of STI activity. Within publication and distribution, for example, primary publication is found to represent an estimated 55 percent of the total, with secondary and tertiary publication only 8 percent. Patent examination represents 32 percent of the total.
- Under documentation, reference, and information services, the library and reference subcategory is the chief one with 62 percent of the STI total, followed by specialized information center services with 34 percent. Networking for these still represents a very small share of the total.
- Symposia and technical meetings make up almost two-thirds the symposia and audiovisual media category, and audiovisual media activities make up more than one-third.

Federal obligations for scientific and technical information by activity: FY 1978 (est.)


$530 million
$161 million Publication & distribution
$263 million Documentation, reference & information services
$32 million Symposia & audiovisual media
$74 million R&D in information sciences, etc.
Primary publication 55%
Patent examination 32%
Secondary & tertiary Publication 8%
Support of publications 6%
Library and reference 62%
Networking for libraries 3%
Specialized information centers 34%
Networking for specialized information centers .4%
Translations 1%
Symposia 65%
Audiovisual media etc. 35%
R&D in information sciences etc. 100%

SOURCE: National Science Foundation

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[10] In the current (1976-78) period the Department of the Army under-reported data for this category; thus, the total is subject to some upward correction.

Agencies

- Of the 24 agencies reporting obligations for STI activities in 1978, seven account for 91 percent of the STI total.
- STI costs are not wholly comparable among agencies; some agencies have full reporting systems while others lack the means to identify relevant STI costs. In the 1976-78 period, 13 Federal agencies reported R&D programs but did not identify any STI activities, although some of their programs may have included such activities. Many STI programs are included within extramural R&D contracts and grants and, thus, are not reported.
- STI efforts do not in all cases bear a direct relationship to the R&D programs of an agency. STI efforts can represent services that are independent of agency R&D activities as, for example, the Patent and Trademark Office within Commerce, the National Agricultural Library within USDA, and the STI activities of the Library of Congress.
- DOD, Commerce, and HEW combined will account for an estimated 69 percent of the STI total in 1978.
- DOD is the leading agency in STI support. Within DOD the Defense Agencies—including the Defense Advanced Research Projects Agency (DARPA), the Defense Nuclear Agency, the Defense Supply Agency, and the Defense Communications Agency—report the largest obligations, mostly because of funding for R&D projects of DARPA and funding for the Defense Documentation Center within Defense Supply. The three services—Army, Navy, and Air Force—also support substantial STI activities, covering all categories.
- Commerce is the next agency in size of support. Most of the STI effort is represented by the Patent and Trademark Office, which is the largest agency subdivision to report STI activities.
- HEW was expected to make up 19 percent of all STI obligations in 1978 with more than four out of five dollars provided by the National Institutes of Health, including the National Library of Medicine.
- The National Library of Congress reports a large share of its overall activities as in support of R&D goals, much related to the social sciences.
- Within Interior the Geological Survey conducts a number of STI programs, including a repository of imagery and data from remote-sensing satellites, a geographic information system, and a water data information system, among others.
- NASA and ERDA are agencies that report small amounts of STI obligations in relation to the size of their R&D programs because so much of their R&D work is performed extramurally, and within extramural R&D contracts and grants STI activities are not identified.

Distribution of Federal obligations for scientific and technical information activities by agency and subdivision: FY 1978 (est.)

[Dollars in millions]

Agency and subdivision	Total obligations	Percent
Total, all agencies	$529.9	100.0
Department of Defense	146.3	27.6
Defense Agencies	59.2	11.2
Department of the Army	48.8	9.2
Department of the Navy	23.1	4.4
Department of the Air Force	15.2	2.9
Department of Commerce	118.7	22.4
Patent and Trademark Office	85.1	16.1
National Technical Information Service	16.7	3.1
National Bureau of Standards	9.9	1.9
National Oceanic and Atmospheric Administration	6.2	1.2
Other	.9	.2
Department of Health, Education, and Welfare	102.2	19.3
National Institutes of Health	84.6	16.0
(National Library of Medicine)	(35.8)	(6.8)
National Institute of Education	5.1	1.0
Alcohol, Drug Abuse and Mental Health Administration	4.6	.9
Food and Drug Administration	4.4	.8
Center for Disease Control	2.8	.5
Other	.8	.2
Library of Congress	38.4	7.3
Department of the Interior	32.2	6.1
Geological Survey	25.5	4.8
National Resources Library	2.2	.4
Other	4.5	.8
National Aeronautics and Space Administration	25.7	4.8
Department of Agriculture	19.1	3.6
National Agricultural Library	6.9	1.3
Forest Service	5.9	1.1
Agricultural Research Service	4.8	.9
Other	1.5	.3
Energy Research and Development Administration	9.3	1.7
National Science Foundation	6.9	1.3
Veterans Administration	6.9	1.3
Smithsonian Instituti[illegible]	6.4	1.2
Department of Trans[illegible]on	4.2	.8
En[illegible]onmental Protection Agency	4.2	.8
Department of Justice	3.4	.6
Department of State	3.0	.6
Consumer Product Safety Commission	1.3	.3
Other agencies	1.7	.3

SOURCE: National Science Foundation

Activities

- Certain agencies tend to account for most of the work in certain categories of activity. Commerce, for example, is predominant in publication and distribution because of patent work; DOD and HEW are predominant in symposia and audiovisual media, and DOD in research and development in information sciences. Most R&D agencies are active in documentation, reference, and information services. STI functions tend to flow back and forth between categories, and the larger the R&D programs of an agency, the more kinds of STI activity are likely to be supported. The following lists are indicative of agency STI activities in 1978.

Category 1. Publication and distribution: $161 million

Commerce: Patent and Trademark Office

70,000 patents in FY 1978 (est.)
Official Gazette, weekly abstracts of current patents
National Technical Information Service
Weekly Government Abstracts

DOD: Departments of the Army, Navy, and Air Force

Journal articles
Technical reports
Technical notes
Technical memorandums
Contractors' and grantees reports
Research reviews
Research bulletins
Research reports
Newsletters
Surveys
Monographs
Proceedings of symposia
Handbooks
Books
Abstracts and bibliographies

NASA

Journal articles
Technical reports, notes, and memorandums
Contractors' reports
Conference proceedings
Scientific and Technical Aerospace Reports (STAR)
International Aerospace Abstracts (IAA)
Indexes
Bibliographies
Technical reprints
Special publications

Interior: Geological Survey

Books
Maps
Charts
Atlases
Research summaries
Journal articles
Bibliography of North American Geology
Geophysical Abstracts

HEW: National Institutes of Health

Journals of the Institutes
Journal articles
Indexes
Bibliographies
Abstracts
Monographs
Books
Reports
Alcohol, Drug Abuse, and Mental Health Administration
Scientific and technical papers
Manuals
Reviews and analyses
Journal articles

USDA

Papers
Bulletins
Reports
Periodicals

ERDA

Technical reports
Progress reports
ERDA Research Abstracts
Energy Abstracts for Policy Analysis
Journal articles
Proceedings of meetings
Progress reviews
Books
Monographs

Category 2. Documentation, reference and information services: $263 million

DOD: Defense Agencies
Defense Documentation Center
Departments of the Army, Navy, and Air Force
Libraries
Specialized information centers
Technical information analysis centers
Translations

ERDA
Energy Information Data Base (EIDB)

HEW: National Institutes of Health
National Library of Medicine
Specialized information centers
Translations
Food and Drug Administration
Specialized information centers
Alcohol, Drug Abuse, and Mental Health Administration
Specialized information centers

National Institute of Education
ERIC clearinghouses

Commerce: Patent and Trademark Office
Search Room
National Technical Information Service (NTIS)
National Bureau of Standards
National Standard Reference Data System (NSRDS)
NOAA
Environmental Data Service

Interior: Geological Survey
Eros Data Center
Geographic Information System
National Cartographic Information System
National Water Data Storage and Retrieval System
Natural Resources Library

NASA
Scientific and Technical Information Facility
Research libraries
Translations

Smithsonian
Science Information Exchange

USDA
National Agricultural Library

Category 3. Symposia and audiovisual media: $32 million

DOD: Departments of the Army, Navy, and Air Force
- Science conferences
- Support of symposia with professional groups, scientific societies, and educational institutions
- Motion pictures
- Slides
- Video tapes
- Exhibits

HEW: National Institutes of Health
- Travel to scientific meetings, U.S. and abroad
- Support to conferences and symposia
- Sound films on physical functions, diseases, and treatment
- TV interviews
- Slides
- Photographs
- Exhibits

NASA
- Participation in and support of scientific symposia and technical meetings

VA
- Participation in seminars and symposia
- Films
- Slides

Category 4: Research and development in information sciences, documentation, and information systems, techniques, and devices: $74 million

DOD: Defense Agencies (largely DARPA)
Departments of the Army, Navy, and Air Force
- R&D in advanced information systems
- Development of engineering data systems
- Support of development of discipline-based information systems
- Studies of man-computer relationships (Project MAC)
- Basic research in information sciences

HEW: National Institutes of Health (including NLM)
- Improvement of Medlars system of NLM
- Development of mechanized searching services in the institutes

Alcohol, Drug Abuse, and Mental Health Administration
- Improvement of information systems

NSF
- Research in storage and retrieval strategies
- Development of access improvement systems and user-oriented science information services

Commerce: National Bureau of Standards
- R&D activities of the Institute for Computer Science and Technology and NSRDS

Library of Congress
- Development of MARC cataloging system

APPENDIXES

A. Technical Notes

B. Federally Funded Research and Development Centers

C. Statistical Tables, Part I

D. Statistical Tables, Part II

Note

The detailed statistical tables for this volume for parts I and II, appendixes C and D, have been published separately under one cover.

Included on pp. 56-65 in this volume are appendix C summary tables 1, 2, and 3, as well as a complete listing of all the tables in appendixes C and D. **Detailed statistical tables may be obtained gratis from the National Science Foundation, Washington, D.C. 20550.**

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APPENDIX A

Technical Notes

SCOPE AND METHOD

This report is organized in two parts. Part I is concerned with Federal funds for research, development, and R&D plant, and part II reports on funds for activities associated with the collection and dissemination of scientific and technical information.

Between March and May of 1977 a total of 37 Federal agencies and their subdivisions—98 individual respondents—submitted data in response to a survey questionnaire developed by the Foundation and distributed in January 1977. With the exception of NASA, the data received from the agencies were in terms of obligations and outlays incurred, or expected to be incurred, regardless of when the funds were appropriated or whether they were identified in the respondent's budget specifically for R&D activities. NASA reported its 1976, 1977, and 1978 transactions in terms of the budget plan, which approximates obligations.

Federal agencies had earlier provided R&D data to the Office of Management and Budget for inclusion in "Special Analysis P: Federal Research and Development Programs" in *The Budget of the United States Government, Fiscal Year 1978*. Although the R&D data in the two reports are reconcilable (See Relation to Other Reports, p. 53), the data in the *Federal Funds* report are more comprehensive and are tabulated in greater detail. Furthermore, the *Federal Funds* report incorporates revisions that have resulted from changes made in the R&D portion of the budget subsequent to the budget message of the President to Congress in January 1977.

DEFINITIONS

Definitions are presented for the two parts of the report. Some definitions in part I are also applicable to part II. The definitions are essentially unchanged from prior issues of the *Federal Funds* series.

Part I. Research, Development, and R&D Plant

(1) RESEARCH, DEVELOPMENT, AND R&D PLANT

This term includes all direct, indirect, incidental, or related costs resulting from or necessary to research, development, and R&D plant, regardless of whether the research and development are performed by a Federal agency (intramural) or performed by private individuals and organizations under grant or contract (extramural). Research and development exclude routine product testing, quality control, mapping and surveys, collection of general-purpose statistics, experimental production, and activities concerned primarily with the dissemination of scientific information and the training of scientific manpower.

a. **Research** is systematic, intensive study directed toward fuller scientific knowledge or understanding of the subject studied. Research is classified as either basic or applied.

In **basic research** the investigator is concerned primarily with gaining a fuller knowledge or understanding of the subject under study.

In **applied research** the investigator is primarily interested in a practical use of the knowledge or understanding for the purpose of meeting a recognized need.

b. **Development** is systematic use of the knowledge and understanding gained from research, directed toward the production of useful materials, devices, systems, or methods, including design and development of prototypes and processes. It excludes quality control, routine product testing, and production.

c. **R&D plant** (R&D facilities and fixed equipment, such as reactors, wind tunnels, and radio telescopes) includes acquisition of, construction of, major repairs to, or alterations in structure, works, equipment, facilities, or land, for use in R&D activities at Federal or non-Federal installations. Excluded from the R&D plant category are expendable equipment and office furniture and equipment. Obligations for foreign R&D plant are limited to Federal funds for facilities located abroad and used in support of foreign research and development.

(2) OBLIGATIONS AND OUTLAYS

a. **Obligations** represent the amounts for orders placed, contracts awarded, services received, and similar transactions during a given period, regardless of when the funds were appropriated and when future payment of money is required.

b. **Outlays** represent the amounts for checks issued and cash payments made during a given period, regardless of when the funds were appropriated.

The obligations and outlays reported cover all transactions from all funds available to the agency from direct appropriations, trust funds or special account receipts, corporate income, or other sources, including funds appropriated by the President, that the agency received or expects to receive. The amounts reported for each year reflect obligations and outlays for that year regardless of when the funds were originally authorized or received and regardless of whether they were appropriated, received, or identified in the agency's budget specifically for research, development, or R&D plant.

An agency making a transfer of funds to another agency includes such transfers in its report of obligations and outlays. The receiving agency does not report, for purposes of this survey, funds transferred to it from another agency. Similarly, a subdivision of an agency that transfers funds to another subdivision within that agency reports such obligations or outlays as its own.

Obligations and outlays for work performed in foreign countries include funds directly available to Federal agencies and special foreign currencies separately appropriated. The latter currencies are derived largely from provisions of Public Law 480, 1954, as amended.

(3) COST COVERAGE

Funds reported for research and development reflect full costs. In addition to costs of specific R&D projects, the applicable overhead costs are also included. The amounts reported include the costs of planning and administering R&D programs, laboratory overhead, pay of military personnel, and departmental administration.

(4) FISCAL YEAR

For 1976, the first year covered by this report, the fiscal year was the Government accounting period beginning July 1, 1975 and ending June 30, 1976. However, in 1977 the Government accounting period began October 1, 1976 and ended September 30, 1977. The months of July through September 1976 made up a transition period to the new Federal fiscal year (Oct. 1—Sept. 30) with the data for this transition period tabulated separately and in broad totals only.

(5) AGENCY

An agency is an organization of the Federal Government whose principal executive officer reports to the President. The only exception (also included in the survey) is the Library of Congress, whose executive officer reports to Congress. The term subdivision refers to any major organizational unit of a reporting agency, such as a bureau, division, office, or service.

(6) PERFORMERS

Performers are either intramural organizations accomplishing operating functions or extramural organizations or persons receiving support or providing services as a result of a contract or grant.

a. **Intramural performers** are the agencies of the Federal Government. Their work is carried on directly by their own personnel. Obligations reported under this category are for activities performed by the reporting agency itself, or they represent funds that the agency transfer to another Federal agency for performance for work. The ultimate performer must be a Federal agency. If the ultimate performer is not a Federal agency, the funds so transferred are reported by the transferring agency under the appropriate extramural performer category (industrial firms, universities, and colleges, other nonprofit institutions). Intramural performance includes the costs of supplies and equipment, essentially of an "off-the-shelf" nature, that are procured for use in intramural research and development. Also included as part of the intramural performance total are the expenses of Federal personnel engaged in planning and administering intramural and extramural R&D programs.

b. **Extramural performers** are all organizations outside the Federal complex that perform with Federal funds under contract or grant. Only costs of actual extramural R&D performance are reported. For example, the purchase from an extramural source of a launch vehicle which is operational, i.e., has gone beyond the development or prototype stage and is used for the performance of research and development, is reported as part of the cost of intramural research and development. Extramural performers are identified as follows:

(i) *Industrial firms* are those organizations that may legally distribute net earnings to individuals or to other organizations.

(ii) *Universities and colleges* are institutions engaged primarily in providing resident instruction for at least a 2-year program above the secondary school level. Included are colleges of liberal arts; schools of arts and sciences; professional schools, such as in engineering and medicine, including affiliated hospitals; associated research institutes; and agricultural experiment stations.

(iii) *Other nonprofit institutions* are private organizations other than educational institutions, no part of whose net earnings inure to the benefit of a private stockholder or individual, and other private organizations organized for the exclusive purpose of turning over their entire net earnings to such nonprofit organizations. Also, private individuals directly awarded R&D grants or contracts are included under nonprofit institutions.

(iv) *Federally funded research and development centers* are R&D-performing organizations exclusively or substantially financed by the Federal Government that are supported by the Federal Government either to meet a particular R&D objective or, in some instances, to provide major facilities at universities for research and associated training purposes. Each center is administered by one of the above extramural performers.

In general, all of the following qualification criteria are met by an institutional unit before it is included in the federally funded research and development center category: (1) Its primary activities include one or more of the following: basic research, applied research, development, or management of research and development (specifically excluded are organizations engaged primarily in routine quality control and testing, routine service activities, production, mapping and surveys, and information dissemination); (2) it is a separate operational unit within the parent organization or is organized as a separately incorporated organization; (3) it performs actual research and development or R&D management either upon direct request of the Federal Government or under a broad charter from the Federal Government, but in either case under the direct monitorship of the Federal Government; (4) it receives its major financial support (70 percent or more) from the Federal Government, usually from one agency; (5) it has or is expected to have a long-term relationship with its sponsoring agency (about 5 years or more), as evidenced by specific obligations assumed by it and the agency; (6) most or all of its facilities are owned or are funded for in the contract with the Federal Government; and (7) it has an average annual budget (operating and capital equipment) of at least $500,000.

(v) *State and local governments* are State and local government agencies, excluding State and local universities and colleges, agricultural experiment stations, medical schools, and affiliated hospitals. Federal R&D funds obligated directly to such State and local educational institutions are included under the universities and colleges performing sector in this survey. Research and development under the State and local category are either performed by the State or local agencies themselves or granted or contracted by such agencies for performance by other organizations. Regardless of the ultimate performer, Federal R&D funds directed to State and local governments are reported under the State and local government sector and no other.

(vi) *Foreign performers* are confined to foreign citizens, organizations, or governments, as well as international organizations, such as NATO, UNESCO, WHO, performing work abroad financed by the Federal Government. Excluded are payments to U.S. agencies, organizations, or citizens performing research and development abroad for the Federal Government (the survey objectives do not include information on "offshore" payments). Also excluded are payments to foreign scientists performing in the United States.

(7) FIELDS OF SCIENCE

The fields of science in this survey are divided into eight broad field categories, most of them consisting of a number of detailed fields. The broad fields are life sciences, psychology, physical sciences, environmental sciences, mathematics and computer sciences, engineering, social sciences, and other sciences not elsewhere classified. The following listing presents the fields grouped under each of the broad fields, together with illustrative disciplines.

a. **Life sciences** consist of the biological, clinical medical, other medical sciences, and life sciences not elsewhere classified.

Life sciences include the following disciplines: Anatomy; animal sciences; bacteriology; biochemistry; biogeography; biological oceanography; biophysics; dentistry; ecology; embryology; entomology; evolutionary biology; genetics; immunology; internal medicine; microbiology; neurology; nutrition and metabolism; opthalmology; parasitology; pathology; pharmacology; pharmacy; physical anthropology; physical medicine and rehabilitation; physiology; plant sciences; podiatry; preventive medicine and public health; psychiatry, radiobiology; radiology; surgery; systematics; veterinary medicine.

Research in some of these disciplines may be classed as biological, clinical medical, or other medical, depending upon the nature of the particular project.

Biological sciences are those which, apart from the clinical medical and other medical sciences as defined below, deal with the origin, development, structure, function, and interactions of living things.

Clinical medical sciences are concerned with the study of the pathogenesis, diagnosis, or therapy of a particular disease or abnormal condition in living human subjects under controlled conditions.

Other medical sciences are concerned with studies of the causes, effects, prevention, or control of abnormal conditions in man or in his environment as they relate to health, except for the clinical aspects as defined above.

Life sciences, nec[1]

b. **Psychology** deals with behavior, mental processes, and individual and group characteristics and abilities. Psychology is divided into three categories: biological aspects, social aspects, and psychological sciences not elsewhere classified. Examples of the disciplines under each of these fields are:

Biological aspects:

Experimental psychology; animal behavior; clinical psychology; comparative psychology; ethology.

Social aspects:

Social psychology; educational, personnel, vocational psychology and testing; industrial and engineering psychology; development and personality.

Psychological sciences, nec[1]

c. **Physical sciences** are concerned with the understanding of the material universe and its phenomena. They comprise the fields of astronomy, chemistry, physics, and physical sciences not elsewhere classified. Examples of the disciplines under each of these fields are

Astronomy:

Laboratory astrophysics; optical astronomy; radio astronomy; theoretical astrophysics; X-ray, Gamma-ray, neutrino astronomy.

Chemistry:

Inorganic; organo-metallic; organic; physical

Physics:

Acoustics; atomic and molecular; condensed matter; elementary particles; nuclear structure; optics; plasma.

Physical sciences, nec[1]

d. **Environmental sciences** (terrestrial and extraterrestrial) are concerned with the gross nonbiological properties of the areas of the solar system which directly or indirectly affect man's survival and welfare; they comprise the fields of atmospheric sciences, geological sciences, oceanography, and environmental sciences not elsewhere classified. Obligations for oceanography are confined to studies supporting physical oceanography. Studies pertaining to life in the sea, or other bodies of water, are reported as support biology. Support of ship operations is, where appropriate, prorated between physical and biological oceanography. Examples of the disciplines under each of these fields follow.

Atmospheric sciences:

Aeronomy; solar; weather modification; extraterrestrial atmospheres; meteorology.

Geological sciences:

Engineering geophysics; general geology; geodesy and gravity; geomagnetism; hydrology; inorganic geochemistry; isotopic geochemistry; organic geochemistry; laboratory geophysics; paleomagnetism; paleontology; physical geography and cartography; seismology; soil sciences.

Oceanography:

Chemical oceanography; geological oceanography; physical oceanography; marine geophysics.

Environmental sciences, nec[1]

e. **Mathematics and computer sciences** employ logical reasoning with the aid of symbols and are concerned with the development of methods of operation employing such symbols, and in the case of computer sciences, with the application of such methods to automated information systems. Examples of disciplines under these fields are

Mathematics:

Algebra; analysis; applied mathematics; foundations and logic; geometry; numerical analysis; statistics; topology.

Computer sciences:

Programming languages; computer and information sciences (general); design, development, and application of computer capabilities to data storage and manipulation; information sciences and systems; systems analysis.

Mathematics and computer sciences, nec[1]

f. **Engineering** is concerned with studies directed toward developing engineering principles or toward making specific scientific principles usable in engineering practice. Engineering is divided into eight fields: aeronautical, astronautical, chemical, civil, electrical, mechanical, metallurgy and materials, and engineering not elsewhere classified. The following are examples of disciplines under each of these fields.

Aeronautical:

Aerodynamics.

Astronautical:

Aerospace; space technology.

Chemical:

Petroleum; petroleum refining; process.

Civil:

Architectural; hydraulic, hydrologic; marine; sanitary and environmental; structural; transportation.

Electrical:

Communication; electronic power.

Mechanical:

Engineering mechanics.

Metallurgy and materials:

Ceramic; mining; textile; welding.

Engineering, nec[1]

Agricultural; industrial and management; nuclear; ocean engineering; systems.

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[1] Not elsewhere classified. Includes multidisciplinary projects within the broad field and single-disciplinary projects for which a separate field has not been assigned.

g. **Social sciences** are directed toward an understanding of the behavior of social institutions and groups and of individuals as members of a group. These sciences include anthropology, economics, political science, sociology, and social sciences not elsewhere classified. The following are examples of the disciplines under the fields of social science:

Anthropology:

Archaeology; cultural and personality; social and ethnology; applied anthropology.

Economics:

Econometrics and economic statistics; history of economic thought; international economics; industrial, labor, and agricultural economics; macroeconomics; microeconomics; public finance and fiscal policy; theory; economic systems and development.

Political science:

Area or regional studies; comparative government; history of political ideas; international relations and law; national political and legal systems; political theory; public administration.

Sociology:

Comparative and historical; complex organizations; culture and social structure; demography; group interactions, social problems and social welfare; sociological theory.

Social sciences, nec[1]

Linguistics; research in education; research in history; socioeconomic geography; research in law, e.g., attempts to assess impact on society of legal systems and practices.

h. **Other sciences not elsewhere classified** includes multidisciplinary and interdisciplinary projects that cannot be classified within one of the above broad fields of science.

(8) GEOGRAPHIC DISTRITRIBUTION OF 1976 R&D OBLIGATIONS

a. Ten agencies participated in the survey on the geographic distribution of obligations for research and development and R&D plant. These 10 respondents accounted for 97 percent of total Federal R&D and R&D plant obligations in 1976. The respondents were the Departments of Agriculture; Commerce; Defense; the Interior; Transportation; and Health, Education and Welfare; the Energy Research and Development Administration; the Environmental Protection Agency; the National Aeronautics and Space Administration; and the National Science Foundation.

b. Data for 1976 were requested in terms of the principal location (State or outlying area) where the work was performed by the prime contractor, grantee, or intramural organization. Where this information was not available in their records, the respondents were asked to assign the obligations to the State, outlying area, etc. where the prime contractor, grantee, or intramural organization was located.

c. Obligations were reported for research and development as a combined amount.

d. Specifically omitted from the survey were R&D obligations to foreign performers and obligations for R&D plant used in support of foreign performers.

Part II. Scientific and Technical Information

Scientific and technical information consists of knowledge or data resulting from the conduct of research and development or required for organizing, planning, or performing research and development. It encompasses any information in recorded or other communicable form which presents the status, progress, or results of research and development in any area of science and technology and which has some potential use in furthering the advancement of current and future research and development.

Exclusions:

a. Training costs for personnel engaged in scientific and technical information activities;

b. Raw scientific and technical data that have not yet been processed for use by professional personnel engaged in research and development (these costs are included in part I of this survey);

c. Statistical and general-purpose data that are collected and organized for other than specific use in research and development;

d. Information that has been prepared primarily to inform or instruct the general public.

Scientific and technical information activities include all efforts directed to the planning, support, control, performance, and improvement of the functions that cover the acquisition, processing, handling, and communication of scientific and technical information. These may include the acquisition, maintenance, or rental of special equipment primarily for use in connection with scientific and technical information activities. These also include meetings and symposia.

Categories of Scientific and Technical Information Activity

(1) PUBLICATION AND DISTRIBUTION

a. **Primary publication** is defined as all document production tasks performed after the author's manuscript or similar initial recording of the information has been finished and leading to but not including initial issuance or distribution of the finished document. Examples of publication activities: Evaluation of a manuscript; professional writing other than by a scientific investigator or engineer engaged in R&D activities; technical or copy editing and revision not performed by the author; technical drawing and artwork; photographing for use in published material; preparation of final copy for printing, microfilm (including computer output microfilm), or machine readable or other reproduction; and composing, typesetting, proofreading, layout, makeup, printing, mimeographing, and photo duplication.

These publication activities may be concerned with any of the following: journals, technical reports, patents, dissertations, data compilations, proceedings of conferences and symposia, specifications and manuals used in the R&D process, monographs, serials.

Distribution includes functions related to the initial transmission or dissemination of newly documented scientific and technical information from source to user, for example, mailing, shipping, and maintenance of controls.

b. **Patent examination** includes all activities involved in judging the allowability of patent claims. Once a claim is granted, further work on a patent enters the primary publication process under Code 11 above.

c. **Secondary and tertiary** publication is defined as all functions related to the preparation, processing, and putting into final form of such publication as: abstracts, indexes, dictionaries, textbooks, handbooks, bibliographies, reviews, encyclopedias, directories.

Distribution includes functions related to the initial transmission or dissemination of newly documented scientific and technical information from source to user, for example, mailing, shipping, and maintenance of controls.

Excluded from primary, secondary, and tertiary publication are costs of preparing audiovisual aids, such as taped talks, slides, and motion picture films. These are included under audiovisual media and other forms of nonprinted communication.

d. **Support of publications** includes all page charges paid out of Federal funds to primary journals, special subscription arrangements to maintain primary journals, and any other special support mechanisms to assure the viability of certain publications.

(2) DOCUMENTATION, REFERENCE AND INFORMATION SERVICES

a. **Library reference and referral services** includes the acquisition, collection, exchange, loan, and storage of scientific and technical documentary materials. These may be books, periodicals, manuals, reports, microfilms, drawings, phonograph records, movie films, and such reference sources as abstract journals, indexes, and subject heading and title lists.

This category includes rental or acquisition and maintenance of computers and other equipment, and costs of their operations. It includes special retrieval services provided in response to user needs (reprography, SDI, demand bibliographies, etc.), sale and loan of documentary materials, dissemination of documents via mail and personal visits, and liaison activities with users and other information services.

Documentation centers, depositories, clearinghouses, and libraries should be reported under this subcategory (a).

b. **Networking for libraries and documentation centers** covers all costs incurred when two or more geographically separate organizations share their scientific or technical information or data resources through computer and telecommunications linkage.

c. **Specialized information center services** (including technical information analysis center and data bank services) cover the collection, analysis, and evaluation of scientific and technical information and data in well-defined, specialized fields; products may be summaries, reviews, or other compilations. Advisory and other user services are included.

Specialized information centers may be either discipline or mission-oriented. The services of these centers are distinguished from those of documentation centers, clearinghouses, and libraries, whose functions are primarily concerned with the handling of documents rather than with the technical information contained in the documents.

d. **Networking for specialized information centers** covers all costs incurred when two or more geographically separate organizations share their scientific or technical information or data resources through computer and telecommunications linkage.

e. **Translations** include all costs involved in the translation of documents and other materials from one language to another in support of R&D activities; also the purchase of foreign journals and other materials to be translated.

(3) SYMPOSIA AND AUDIOVISUAL MEDIA

a. **Symposia and technical meetings** include all efforts directed to planning, scheduling, announcing, supporting, sponsoring, conducting, and attending symposia, conferences, and meetings primarily concerned with exchanging and disseminating scientific and technical information. The travel and subsistence of participants in such symposia, conferences, and meetings are covered in these costs.

b. **Audiovisual media and other forms of nonprinted communication** refer to the costs of producing technical and documentary motion picture films, slides, and special photographs for R&D communications purposes, as well as audio and visual aids, such as taped talks, television film, or visual magnetic tape. This category also includes exhibits but excludes media primarily intended for training or public information purposes.

(4) RESEARCH AND DEVELOPMENT IN INFORMATION SCIENCES, DOCUMENTATION AND INFORMATION SYSTEMS, TECHNIQUES AND DEVICES

This category includes the conduct and support of research and development of new and nonconventional methods, techniques, systems, and machines for improving scientific and technical information functions under each of the other three categories, and also includes research and development of a fundamental nature in the area of scientific information. It also covers the conduct and support of studies and surveys to identify broad and specific aspects of scientific information problems. Examples of activities included under this category are as follows:

Development and testing of machines, devices, and techniques for storage and retrieval of information and data;
linguistics research focused on information processing;
language and machine translation;
information theory;
artificial intelligence;
logic and switching theory;
operations or systems research on scientific and technical information systems and processes;
documentation or document storage and retrieval;
library science;
network design;
studies of subject classification and indexing schemes; and
studies of scientific and technical information communication systems

Note: Research and development conducted at documentation centers, libraries, and specialized information centers should be included but not the costs associated with establishing new centers or systems once past the development stage. As soon as any new system moves out of the experimental phase and into the operational phase, its costs should be reported under the appropriate category and subcategory above and no longer under this category.

CHANGES IN REPORTING

Responses from the agencies in this survey, as in the previous ones, reflect updating of estimates for the latest two years of the previous report. Such updating is normal in the budgetary cycle. In addition, from time to time responses have reflected reappraisals and revisions in classification of various phases of agencies R&D programs. When this has occurred, the National Science Foundation has revised prior-year data to maintain consistency and comparability with the most recent reporting. Since no statistical inquiry is free of problems of concepts and definitions for the respondents, revisions to improve the reporting are encouraged by NSF.

LIMITATIONS OF THE DATA

Funds for research, development, and other scientific activities are reported on a 3-year basis comparable with the 1978 budget, upon which the data are based. The respondents have reconciled the data reported here with amounts for scientific activities shown in *The Budget of the United States Government, Fiscal Year 1978*. The amounts reported for each year indicate the obligations or outlays incurred in that year, regardless of when the funds were authorized or received by an agency and regardless of whether or not the funds were identified in the agency's budget specifically for research, development, R&D plant, or scientific and technical information activities.

Data submitted by the Federal agencies for 1976 are considered to be actual since they represent essentially completed transactions. Amounts reported for 1977 and 1978 are estimates in that they are subject to further appropriation, apportionment, or allocation decisions. The actual effects of those and other later actions on 1977 and 1978 outlays and obligations will be reflected in the next report.

It is important to bear in mind that judgment is often necessary in classifying the data. Because of the scope of R&D programs and their multidisciplinary nature, it is difficult to

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establish consistent criteria for allocating efforts among the character-of-work categories and the various fields of science. Often funds for R&D activities may not be specifically identified in an agency's budget. Nonetheless, to meet survey requirements, the participating agencies have developed over the years increasingly consistent systems for classifying R&D data. Revisions resulting from changes in an agency's reporting practices have been incorporated into the historical data to improve the comparability and consistency of the statistical series.

In some cases however, agencies have not found it possible to report the full cost of research and development. For example, the headquarters costs of planning and administering R&D programs of DOD and ERDA are not included in these reports because these agencies have indicated that it is administratively impracticable to identify the amounts.

R&D plant data reported here are to some extent understated because of the difficulty encountered by some agencies, particularly DOD and NASA, in identifying and reporting this information. While DOD reports obligations for R&D plant funded by its construction appropriation. DOD is able to identify only a small portion of the amount of R&D plant support included in R&D contracts that were funded from its RDT&E appropriation. NASA does not separately identify those portions of industrial R&D contracts used for R&D plant but includes R&D plant amounts under the R&D total for performance by industrial firms.

In the area of scientific and technical information, extramural obligations are limited to funds allocated for grants and contracts that are primarily for the support of scientific and technical information activities. As in prior volumes of this series, extramural funds for information activities performed as supplemental, supporting services under R&D grants or contracts have been excluded.

RELATION TO OTHER REPORTS

(1) FEDERAL SUPPORT TO UNIVERSITIES AND COLLEGES

The National Science Foundation prepares reports covering Federal support of individual colleges and universities. These reports are based on data provided by the Federal agencies in response to the reporting system established by the Committee on Academic Science and Engineering (CASE) of the Federal Council for Science and Technology. These reports are referred to in this publication as the CASE reports.

Both the CASE and *Federal Funds* reports provide data on Federal obligations for research and development and R&D plant to universities and colleges and to university-administered federally funded research and development centers (FFRDC's). The CASE report, however, is based on obligations of Federal agencies to each individual academic institution, while the *Federal Funds* report is concerned with obligations to universities and colleges as a performer group. The CASE report also includes funds for non-R&D activities, such as science education and nonscience support. Further, the CASE study is based on reports of only 14 agencies (the Departments of Agriculture; Commerce; Defense; Health, Education, and Welfare; Housing and Urban Development; the Interior; Labor; and Transportation; the Energy Research and Development Administration; the Environmental Protection Agency; the National Aeronautics and Space Administration; the National Science Foundation; the Agency for International Development; and the Nuclear Regulatory Commission) while *Federal Funds* is composed of obligations of all agencies. The 14 respondents for CASE account for more than 99 percent of the Federal R&D total to univeristies and colleges and all obligations to university-administered FFRDC's.

The different reporting procedures have led to different amounts being reported by CASE and *Federal Funds* as follows:

a. The obligations for research and development to universities and colleges reported for *Federal Funds* in 1976 amounted to $2,526 million, or $107 million more than the amount reported for CASE. Part of this difference can be attributed to variations in the amounts reported by the National Institutes of Health (HEW). The *Federal Funds* R&D total for the National Institutes of Health included funds for General Research Support grants, whereas in CASE these were placed under the category of "general support for science," which is a non-R&D area under the CASE definition.

b. The R&D obligation total to university-administered FFRDC's reported for *Federal Funds* was $1,061 million in 1976, or $222 million less than reported for CASE. For *Federal Funds* $148 million subcontracted by NASA's Jet Propulsion Laboratory was included in ultimate-performer categories (mainly industry) while for CASE the subcontracted amount was included in the R&D obligations to FFRDC's administered by universities.

c. The total R&D plant obligations to universities and colleges reported for *Federal Funds* was $35 million in 1976, or $11 million more than the amount reported for CASE.

d. The total R&D plant obligations to FFRDC's administered by universities and colleges reported for *Federal Funds* was $190 million in 1976, or $27 million more than reported for CASE.

The following factors should also be considered in comparing the data appearing in the two reports:

For *Federal Funds* each agency includes in its own obligations the amounts transferred to other agencies for furtherance of its work, and the receiving agencies do not report funds transferred to them. On the other hand, in the CASE survey, the data are reported by the agency that made the final distribution of the funds to a given institution. Thus, for the CASE survey, agencies included funds received from other agencies, and excluded funds transferred to other agencies, the reverse of the *Federal Funds* process. While such transfers should balance each other out with no resulting changes in total R&D obligations, these varying reporting practices do add to the possibility of differences between the two reports.

The CASE reports, in most instances, are prepared by different operational units within each agency than those that prepare the *Federal Funds* responses. Furthermore, the CASE data are collected several months earlier than the *Federal Funds* statistics. Although, in theory, these conditions in themselves should not lead to reporting differences, in practice differences do arise.

(2) SPECIAL ANALYSES, BUDGET OF THE UNITED STATES

In a section of *Special Analyses, Budget of the United States Government*, the Office of Management and Budget (OMB) publishes estimates of obligations and outlays for research, development, and R&D plant. However, the data in "Special Analysis P: Federal Research and Development Programs" in the 1978 budget do not provide as much detail on character of work or performers as *Federal Funds* and no information on fields of science or geographic distribution.

"Special Analysis P" and *Federal Funds* utilize the same definitions for research and development and for R&D plant. The estimates for research and development published in the two reports are comparable, even though minor differences exist. The differences between the two reports are as follows:

Total R&D obligations
[Billions of dollars]

	FY 1976	FY 1977	FY 1978
Federal Funds	$20.8	$24.5	$26.3
Special Analysis P	20.7	24.5	26.3

(3) AN ANALYSIS OF FEDERAL R&D FUNDING BY FUNCTION, FY 1969-78

NSF publishes a report under the above title, providing an analysis of Federal R&D obligations by functional categories. The annual *Federal Funds* series, by contrast, reports on Federal R&D obligations by agencies but not by functional categories. The R&D obligation data for 1969-78 in the function report were based on information submitted by the agencies for the *Federal Funds* series. Thus, the overall R&D obligations are the same in both reports for the same years covered.

(4) OTHER REPORTS

a. Individual agencies may classify their R&D programs for purposes other than those for which the *Federal Funds* survey is conducted. Definitions and guidelines that are suitable to those other purposes may result in information that is not comparable with the data transmitted to the Foundation for *Federal Funds*.

b. *The Budget of the United States Government, Fiscal Year 1978* is the source of data on outlays, but the NSF definition of relatively uncontrollable outlays differs from that of OMB in that OMB designates outlays from prior-year contracts and obligations as relatively uncontrollable, whereas NSF considers this category of outlays to be initially controllable and therefore different in concept from fixed-cost and open-ended programs like social security, veterans compensation and pensions, and interest on the national debt.

The latter class of outlays are uncontrollable in that a change in their disbursement requires a change in existing substantive law. All outlays which require appropriation decisions by the Congress, however, are considered by NSF to be relatively controllable; such outlays cover all R&D programs. See *The Budget, 1978*, p. 420.

SOURCES

Data on R&D funds in this report for years prior to 1952 were compiled by the Bureau of the Budget, which later became the Office of Management and Budget, and subsequent data were based on NSF surveys. These data have been published in previous issues of this series, but certain adjustments have been made to achieve comparability with the latest reporting concepts evolved by the agencies.

Supplementing the statistical data collected through the NSF survey of Federal agencies, a variety of sources were used for the text of this report, including the narrative statements submitted by the agencies in the NSF survey, published records of testimony presented by agencies to committees of the Senate and the House, the *1978 Budget Appendix*, and personal contacts with agency respondents.

APPENDIX B

Federally Funded Research and Development Centers, Fiscal Years 1976-78

Department of Defense

OFFICE OF THE SECRETARY OF DEFENSE

Administered by other nonprofit institutions:

Institute for Defense Analyses (IDA)

DEPARTMENT OF THE NAVY

Administered by universities and colleges:

Applied Physics Laboratory (Johns Hopkins University)[1]
Applied Research Laboratory (Pennsylvania State University)[2]
Center for Naval Analyses (University of Rochester)

DEPARTMENT OF THE AIR FORCE

Administered by universities and colleges:

Lincoln Laboratory (Massachusetts Institute of Technology)

Administered by other nonprofit institutions:

Aerospace Corporation
Analytic Services, Inc. (ANSER)
MITRE Corporation
Project Air Force (RAND Corporation)

Department of Health, Education, and Welfare

NATIONAL INSTITUTES OF HEALTH

Administered by industrial firms:

Frederick Cancer Research Center (Litton Bionetics, Inc., Litton Industries)

Energy Research and Development Administration

Administered by industrial firms:

Bettis Atomic Power Laboratory (Westinghouse Electric Corp.)
Hanford Engineering Development Laboratory (Westinghouse-Hanford Corp.)
Idaho National Engineering Laboratory (Aerojet Nuclear Corp.)
Knolls Atomic Power Laboratory (General Electric Company)
Liquid Metal Engineering Center (Rockwell International Corporation)
Mound Laboratory (Monsanto Research Corp.)
Oak Ridge National Laboratory (Union Carbide Corp.)
Sandia Laboratory (Western Electric Co., Inc.-Sandia Corp.)
Savannah River Laboratory (E.I. du Pont de Nemours & Co., Inc.)

Administered by universities and colleges:

Ames Laboratory (Iowa State University of Science and Technology)
Argonne National Laboratory (University of Chicago and Argonne Universities Assn.)
Brookhaven National Laboratory (Associated Universities, Inc.)
E. O. Lawrence Berkeley Laboratory (University of California)
E. O. Lawrence Livermore Laboratory (University of California)
Fermilab (Universities Research Association, Inc.)
Los Alamos Scientific Laboratory (University of California)
Oak Ridge Associated Universities
Plasma Physics Laboratory (Princeton University)
Stanford Linear Accelerator Center (Stanford University)

Administered by other nonprofit institutions:

Pacific Northwest Laboratory (Battelle Memorial Institute)

National Aeronautics and Space Administration

Administered by universities and colleges:

Jet Propulsion Laboratory (California Institute of Technology)
Space Radiation Effects Laboratory (College of William and Mary)

National Science Foundation

Administered by universities and colleges:

Cerro Tololo Inter-American Observatory (Association of Universities for Research in Astronomy, Inc.)
Kitt Peak National Observatory (Association of Universities for Research in Astronomy, Inc.)
National Astronomy and Ionosphere Center (Cornell University)
National Center for Atmospheric Research (University Corporation for Atmospheric Research)
National Radio Astronomy Observatory (Associated Universities, Inc.)

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[1] No longer an FFRDC as of fiscal year 1978.
[2] No longer an FFRDC as of fiscal year 1977.

APPENDIX C

Statistical Tables
Part 1

Federal Funds for Research, Development and R&D Plant

RESEARCH, DEVELOPMENT, AND R&D PLANT

C-1. Overall summary: fiscal years 1976, 1977, and 1978 ....
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C-4. By agency and character of work: fiscal year 1976 ....
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C-8. By agency and performer: fiscal year 1977 (estimated) ....
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C-19. Psychology and physical sciences, by agency and detailed field of science: fiscal year 1978 (estimated) ....
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C-55. Psychology and physical sciences, by agency and detailed field of science: fiscal year 1976 ....
C-56. Psychology and physical sciences, by agency and detailed field of science: fiscal year 1977 (estimated) ....
C-57. Psychology and physical sciences, by agency and detailed field of science: fiscal year 1978 (estimated) ....
C-58. Life and environmental sciences, by agency and detailed field of science: fiscal year 1976 ....
C-59. Life and environmental sciences, by agency and detailed field of science: fiscal year 1977 (estimated) ....
C-60. Life and environmental sciences, by agency and detailed field of science: fiscal year 1978 (estimated) ....
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C-63. Engineering, by agency and detailed field of science: fiscal year 1978 (estimated) ......
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C-80. By detailed field of science: fiscal years 1976, 1977, and 1978 ....
C-81. By agency and field of science: fiscal year 1976 ....
C-82. Psychology and physical sciences, by agency and detailed field of science: fiscal year 1976 ....
C-83. Life and environmental sciences, by agency and detailed field of science: fiscal year 1976 ....
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APPLIED RESEARCH PERFORMED AT UNIVERSITIES AND COLLEGES—AGENCY AND FIELD OF SCIENCE

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C-113. Research, development, and R&D plant, by agency: fiscal years 1968-78 ....
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C-117. Total research, by selected agency: selected fiscal years 1968-78 ....
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C-123. Basic research, by performer: selected fiscal years 1968-78 ....
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C-125. Development by performer: selected fiscal years 1968-78 ....
C-126. Total research, by field of science: selected fiscal years 1968-78 ....
C-127. Basic research, by field of science: selected fiscal years 1968-78 ....
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C-129. Research and development, by geographic division and State: fiscal years 1968-76 ....
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NOTES

- Estimates for 1978 are based on *The Budget of the United States Government, Fiscal Year 1978* as submitted to Congress, and do not reflect subsequent appropriations and apportionment actions.
- Details may not add to totals because of rounding.
- Asterisks appearing in lieu of figures indicate that the amounts are less than $50,000.
- The abbreviation "FFRDC's" appearing in statistical tables refers to federally funded research and development centers.
- Defense Agencies within the Department of Defense include the Defense Advanced Research Projects Agency, the Defense Nuclear Agency, the Defense Communications Agency, the Defense Mapping Agency, the Defense Logistics Agency, the Uniformed Services University of the Health Sciences, and technical support, Office of the Secretary of Defense.
- Departmentwide funds of the Department of Defense cover the Defense Civil Preparedness Agency.
- R&D data reported by the National Aeronautics and Space Administration are in terms of budget plan rather than obligations.

- In tables showing extramural performers, obligations to agricultural experiment stations are included within obligations to universities and colleges.
- The current appendix tables (Volume XXVI) providing data on R&D totals for 1971 through 1975 are not comparable with totals for those years in appendix tables issued to accompany earlier *Federal Funds* reports. Basic research and applied research totals for 1975 and development totals for 1971, 1973, and 1975 have also been changed. Performer totals for 1971 through 1975 are likewise not comparable with data in earlier appendix tables. In the appendix tables for the previous report (Volume XXV) data on basic research, applied research, and development had been changed so that they were no longer comparable with data reported under those categories in appendix tables for previous reports. Some of the historical data were missing (for the years 1968, 1970, 1972, and 1974). These data are now included in the current appendix tables (Volume XXVI) and are shown on the revised basis used in the previous-year appendix tables.

NOTE: For trend comparisons, use only these appendix tables C and D for Volume XXVI and not any earlier ones.

Table C-1. Summary of Federal funds for research, development, and R&D plant: fiscal years 1976, 1977, and 1978

[Millions of dollars]

Item	Actual 1976	Estimates	
		1977	1978
Total outlays for research, development, and R&D plant	20,687.9	23,244.0	25,850.5
Research and development	19,892.9	22,278.2	24,623.6
R&D plant	795.1	965.7	1,226.9
Total obligations for research, development, and R&D plant	21,595.3	26,068.8	27,883.1
Research and development	20,758.6	24,465.3	26,316.7
Performers:			
Federal intramural[1]	5,710.0	6,467.0	6,547.6
Industrial firms	9,414.6	11,402.2	12,918.9
FFRDC's administered by industrial firms	848.9	1,061.5	1,150.0
Universities and colleges	2,525.9	2,851.1	3,060.1
FFRDC's administered by universities and colleges	1,061.1	1,194.6	1,217.0
Nonprofit institutions	692.5	768.7	771.7
FFRDC's administered by nonprofit institutions	231.0	252.6	220.5
State and local governments	201.5	365.3	353.3
Foreign	73.1	102.2	77.5
Research	7,873.3	8,853.3	9,490.5
Performers:			
Federal intramural[1]	2,868.1	3,161.8	3,297.9
Industrial firms	1,364.2	1,555.3	1,803.0
FFRDC's administered by industrial firms	182.7	222.6	257.2
Universities and colleges	2,267.6	2,545.1	2,719.5
FFRDC's administered by universities and colleges	549.1	631.7	659.8
Nonprofit institutions	442.5	499.6	522.1
FFRDC's administered by nonprofit institutions	57.7	49.5	54.2
State and local governments	92.7	123.3	125.0
Foreign	48.7	64.4	51.9
Fields of science:			
Life sciences	2,646.1	2,983.4	3,105.5
Psychology	140.3	164.1	178.0
Physical sciences	1,220.6	1,405.6	1,569.9
Environmental sciences	770.3	852.3	925.0
Mathematics and computer sciences	152.9	165.6	183.8
Engineering	2,378.0	2,601.6	2,810.8
Social sciences	390.0	456.5	482.2
Other sciences	175.2	224.1	235.3
Basic research	2,425.5	2,754.7	3,011.8
Performers:			
Federal intramural[1]	719.1	790.9	851.4
Industrial firms	108.3	151.7	197.2
FFRDC's administered by industrial firms	43.3	49.4	52.9
Universities and colleges	1,137.1	1,290.2	1,398.9
FFRDC's administered by universities and colleges	284.3	315.1	347.3
Nonprofit institutions	101.0	117.6	122.3
FFRDC's administered by nonprofit institutions	7.4	7.2	8.7
State and local governments	10.2	14.4	16.0
Foreign	14.8	18.2	17.1
Fields of science:			
Life sciences	877.7	1,007.1	1,058.3
Psychology	43.7	52.6	57.5
Physical sciences	721.6	806.3	910.7
Environmental sciences	354.6	393.6	438.1
Mathematics and computer sciences	70.2	79.4	87.8
Engineering	240.0	267.8	297.1
Social sciences	85.2	102.0	113.4
Other sciences	32.6	46.0	49.0

Applied research	5,447.8	6,098.6	6,478.6
Performers:			
Federal intramural[1]	2,149.1	2,370.9	2,446.5
Industrial firms	1,255.9	1.403.6	1,605.8
FFRDC's administered by industrial firms	139.4	173.2	204.2
Universities and colleges	1,130.5	1,254.9	1,320.5
FFRDC's administered by universities and colleges	264.8	316.6	312.5
Nonprofit institutions	341.5	382.0	399.8
FFRDC's administered by nonprofit institutions	50.3	42.3	45.5
State and local governments	82.4	108.9	109.0
Foreign	33.9	46.2	34.8
Fields of science:			
Life sciences	1,768.4	1,976.3	2,047.2
Psychology	96.7	111.5	120.5
Physical sciences	499.0	599.3	659.2
Environmental sciences	415.7	458.7	486.9
Mathematics and computer sciences	82.7	86.2	96.1
Engineering	2,138.0	2,333.8	2,513.7
Social sciences	304.7	354.6	368.8
Other sciences	142.6	178.2	186.3
Development	12,885.3	15,612.0	16,826.2
Performers:			
Federal intramural[1]	2,841.8	3,305.2	3,249.8
Industrial firms	8,050.4	9,847.0	11,115.9
FFRDC's administered by industrial firms	666.2	838.8	892.8
Universities and colleges	258.3	306.1	340.7
FFRDC's administered by universities and colleges	512.0	563.0	557.1
Nonprofit institutions	250.0	269.1	249.6
FFRDC's administered by nonprofit institutions	173.3	203.2	166.3
State and local governments	108.8	242.0	228.3
Foreign	24.4	37.7	25.7
R&D plant	836.7	1,603.5	1,566.5
Performers supported:			
Federal intramural	316.8	777.3	603.4
Industrial firms	73.7	215.9	270.3
FFRDC's administered by industrial firms	205.9	220.8	268.1
Universities and colleges	35.2	49.7	49.8
FFRDC's administered by universities and colleges	189.6	324.1	362.4
Nonprofit institutions	10.9	8.9	6.0
FFRDC's administered by nonprofit institutions	4.7	6.4	5.8
State and local governments	—	.3	.7
Foreign	—	—	—

[1] Costs associated with the administration of intramural and extramural programs are covered as well as actual intramural performance.

SOURCE: National Science Foundation

TABLE C-2. FEDERAL FUNDS FOR RESEARCH, DEVELOPMENT, AND R&D PLANT, BY AGENCY: FISCAL YEARS 1976, 1977, AND 1978

(MILLIONS OF DOLLARS)

AGENCY AND SUBDIVISION	OBLIGATIONS			OUTLAYS		
	ACTUAL,	ESTIMATES		ACTUAL,	ESTIMATES	
	1976	1977	1978	1976	1977	1978
TOTAL, ALL AGENCIES	21,595.3	26,068.8	27,883.1	20,687.9	23,244.0	25,850.5
DEPARTMENTS						
DEPARTMENT OF AGRICULTURE, TOTAL	478.6	547.9	588.4	468.8	570.7	592.2
AGRICULTURAL RESEARCH SERVICE	255.3	296.9	323.3	247.4	325.4	323.1
COOPERATIVE STATE RESEARCH SERVICE	113.4	128.7	136.4	104.2	131.6	139.4
ECONOMIC RESEARCH SERVICE	24.0	26.2	28.3	23.6	26.2	28.3
FARMER COOPERATIVE SERVICE	1.2	1.3	1.6	1.4	1.3	1.6
FOREST SERVICE	82.8	92.7	96.7	90.3	84.1	97.7
NATIONAL AGRICULTURAL LIBRARY	*	-	-	*	*	-
STATISTICAL REPORTING SERVICE	1.9	2.1	2.1	2.0	2.1	2.1
DEPARTMENT OF COMMERCE, TOTAL	235.5	254.8	245.2	233.3	249.9	257.0
BUREAU OF THE CENSUS	2.5	2.7	2.8	2.5	2.7	2.8
ECONOMIC DEVELOPMENT ADMINISTRATION	15.1	14.6	4.5	13.6	13.1	12.5
MARITIME ADMINISTRATION	21.2	23.0	20.5	24.4	20.6	24.3
NATIONAL BUREAU OF STANDARDS	47.9	54.7	51.9	49.1	54.9	52.0
NATIONAL FIRE PREVENTION AND CONTROL ADMINISTRATION	6.4	7.0	6.7	4.6	6.6	7.9
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	139.1	149.4	155.8	134.5	148.1	154.4
OFFICE OF MINORITY BUSINESS ENTERPRISE	2.0	2.0	1.6	3.2	1.8	1.6
OFFICE OF TELECOMMUNICATIONS	.9	1.0	1.0	1.1	1.7	1.0
PATENT AND TRADEMARK OFFICE	.4	.4	.4	.4	.4	.4
DEPARTMENT OF DEFENSE, TOTAL	9,798.1	11,639.9	12,456.7	9,092.7	10,094.0	11,291.9
DEPARTMENT OF THE ARMY	2,026.0	2,526.5	2,713.8	1,969.6	2,341.7	2,536.2
MILITARY FUNCTIONS	1,997.4	2,500.7	2,683.7	1,941.2	2,316.1	2,506.1
RDT&E APPROPRIATIONS	1,906.1	2,388.5	2,553.2	1,841.6	2,213.0	2,410.2
PAY AND ALLOWANCES OF MILITARY PERSONNEL IN R&D	86.9	92.5	92.3	86.9	92.5	92.3
MILITARY CONSTRUCTION	4.4	19.7	38.2	12.7	10.6	3.6
CIVIL FUNCTIONS	28.6	25.8	33.1	28.4	25.6	30.1
DEPARTMENT OF THE NAVY	3,373.8	3,929.9	4,359.3	3,320.1	3,673.5	4,096.3
RDT&E APPROPRIATIONS	3,279.0	3,816.9	4,216.3	3,214.9	3,566.0	3,985.7
PAY AND ALLOWANCES OF MILITARY PERSONNEL IN R&D	81.1	91.1	84.2	81.1	91.1	84.2
MILITARY CONSTRUCTION	10.8	18.3	55.6	19.3	13.4	23.4
SPECIAL FOREIGN CURRENCY PROGRAM	2.9	3.6	3.2	4.8	3.0	3.0
DEPARTMENT OF THE AIR FORCE	3,799.6	4,457.9	4,585.1	3,625.2	3,887.3	4,454.8
RDT&E APPROPRIATIONS	3,516.5	3,889.4	4,211.4	3,338.0	3,579.0	4,027.9
PAY AND ALLOWANCES OF MILITARY PERSONNEL IN R&D	245.1	251.7	241.9	245.1	251.7	241.9
MILITARY CONSTRUCTION	38.0	316.8	131.8	42.1	56.6	185.0
DEFENSE AGENCIES	573.9	687.1	771.7	154.7	162.4	175.4
RDT&E APPROPRIATIONS	573.9	687.1	771.7	154.7	162.4	175.4
DEPARTMENTWIDE FUNDS	.7	.9	1.7	2.2	1.1	1.2
DIRECTOR OF TEST AND EVALUATION, DEFENSE	24.1	37.6	25.1	20.9	28.0	28.0
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, TOTAL	2,579.0	3,102.8	3,092.7	2,615.0	2,626.3	2,996.8
ALCOHOL, DRUG ABUSE AND MENTAL HEALTH ADMINISTRATION	139.5	155.0	155.5	145.1	140.6	151.6
CENTER FOR DISEASE CONTROL	49.6	60.4	59.5	37.1	77.9	62.5
FOOD AND DRUG ADMINISTRATION	38.0	44.7	47.4	19.0	38.1	43.0
HEALTH RESOURCES ADMINISTRATION	38.2	37.0	33.7	24.7	36.3	30.2
HEALTH SERVICES ADMINISTRATION	17.5	21.4	14.9	11.3	15.9	17.3
NATIONAL INSTITUTE OF EDUCATION	63.7	85.7	104.0	69.8	88.4	93.9
NATIONAL INSTITUTES OF HEALTH	2,054.8	2,375.3	2,378.3	2,118.4	1,998.5	2,312.7
OFFICE OF EDUCATION	58.2	174.7	150.0	56.8	76.7	132.8
OFFICE OF HUMAN DEVELOPMENT	61.9	78.1	72.1	61.4	83.2	77.2
OFFICE OF THE ASSISTANT SECRETARY FOR EDUCATION	1.0	1.0	1.0	1.5	1.7	1.6
OFFICE OF THE SECRETARY	23.7	20.0	22.4	32.5	22.0	22.5
SOCIAL AND REHABILITATION SERVICE	18.6	29.3	31.2	18.6	29.3	31.2
SOCIAL SECURITY ADMINISTRATION	14.4	20.1	22.8	18.9	17.8	20.2
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT	67.6	62.7	67.7	60.3	66.3	70.8
DEPARTMENT OF THE INTERIOR, TOTAL	320.2	357.7	361.6	304.0	350.4	367.1
BONNEVILLE POWER ADMINISTRATION	7.1	5.8	3.4	8.3	6.6	3.8
BUREAU OF LAND MANAGEMENT	.7	.9	1.4	.7	.9	1.4
BUREAU OF MINES	131.3	153.7	135.9	113.7	147.1	141.8
BUREAU OF OUTDOOR RECREATION	*	*	*	*	*	*
BUREAU OF RECLAMATION	8.3	10.3	9.0	8.7	11.4	9.0
GEOLOGICAL SURVEY	119.2	130.8	152.6	125.0	130.0	151.9
NATIONAL PARK SERVICE	9.3	9.9	11.8	9.3	9.9	11.8
OFFICE OF THE SECRETARY	1.0	4.9	2.4	.7	3.6	2.2
OFFICE OF WATER RESEARCH AND TECHNOLOGY	19.0	19.5	21.1	19.0	19.5	21.1
UNITED STATES FISH AND WILDLIFE SERVICE	24.2	21.7	23.9	18.5	21.3	24.0

CONTINUED ON NEXT PAGE

TABLE C-2. FEDERAL FUNDS FOR RESEARCH, DEVELOPMENT, AND R&D PLANT, BY AGENCY: FISCAL YEARS 1976, 1977, AND 1978

(MILLIONS OF DOLLARS)

- CONTINUED

AGENCY AND SUBDIVISION	OBLIGATIONS			OUTLAYS		
	ACTUAL, 1976	ESTIMATES		ACTUAL, 1976	ESTIMATES	
		1977	1978		1977	1978
DEPARTMENT OF JUSTICE, TOTAL	33.9	45.0	39.0	39.9	44.1	40.4
BUREAU OF PRISONS	.8	1.3	2.0	.7	1.2	1.6
DRUG ENFORCEMENT ADMINISTRATION	2.5	6.5	3.3	2.6	4.6	4.8
FEDERAL BUREAU OF INVESTIGATION	1.2	1.4	1.8	1.4	2.6	2.0
IMMIGRATION AND NATURALIZATION SERVICE	.1	.8	.4	-	.8	.4
LAW ENFORCEMENT ASSISTANCE ADMINISTRATION	29.2	35.0	29.5	35.2	35.0	29.5
OFFICE OF THE ATTORNEY GENERAL	-	-	2.0	-	-	2.0
DEPARTMENT OF LABOR, TOTAL	28.5	34.6	33.2	27.8	34.6	33.2
BUREAU OF LABOR STATISTICS	1.3	1.4	1.2	1.3	1.4	1.2
EMPLOYMENT AND TRAINING ADMINISTRATION	17.5	19.1	17.3	17.5	19.1	17.3
EMPLOYMENT STANDARDS ADMINISTRATION	4.3	5.5	5.6	4.1	5.5	5.6
LABOR-MANAGEMENT SERVICES ADMINISTRATION	.7	2.9	3.0	.7	2.9	3.0
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION	2.9	3.3	4.3	2.9	3.3	4.3
OFFICE OF THE SECRETARY	1.8	2.3	1.9	1.2	2.3	1.9
DEPARTMENT OF STATE, TOTAL	44.5	51.4	84.3	27.0	48.4	63.4
DEPARTMENTAL FUNDS	1.6	1.6	2.3	1.6	1.6	2.3
AGENCY FOR INTERNATIONAL DEVELOPMENT	42.9	49.8	82.0	25.4	46.8	61.1
DEPARTMENT OF TRANSPORTATION, TOTAL	308.7	432.3	420.0	335.7	397.2	393.4
FEDERAL AVIATION ADMINISTRATION	100.1	120.5	129.2	114.6	114.9	127.6
FEDERAL HIGHWAY ADMINISTRATION	29.3	54.8	54.8	42.9	48.9	54.7
FEDERAL RAILROAD ADMINISTRATION	60.5	80.9	57.0	48.5	64.4	46.3
MATERIALS TRANSPORTATION BUREAU	-	-	1.0	-	-	.6
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION	31.4	58.9	51.3	33.8	58.0	47.9
OFFICE OF THE SECRETARY	25.8	33.1	31.2	29.9	31.0	31.2
UNITED STATES COAST GUARD	12.8	22.9	22.7	17.8	22.0	21.0
URBAN MASS TRANSPORTATION ADMINISTRATION	48.8	61.2	72.8	48.2	58.0	64.1
DEPARTMENT OF THE TREASURY, TOTAL	3.8	5.4	6.9	3.8	6.0	6.8
BUREAU OF ALCOHOL, TOBACCO, AND FIREARMS	-	1.3	2.3	-	1.3	2.3
BUREAU OF ENGRAVING AND PRINTING	2.8	2.8	2.9	2.8	2.8	2.9
CUSTOMS SERVICE	1.1	1.3	1.7	1.1	1.9	1.6
OTHER AGENCIES						
ACTION	.1	.3	.3	.1	.3	.3
ADVISORY COMMISSION ON INTERGOVERNMENTAL RELATIONS	1.0	1.2	1.4	1.0	1.2	1.4
APPALACHIAN REGIONAL COMMISSION	.7	.8	.8	.7	.8	.8
CIVIL AERONAUTICS BOARD	.4	.5	.5	.4	.5	.5
CIVIL SERVICE COMMISSION	4.0	3.8	3.8	4.0	3.8	3.8
COMMUNITY SERVICES ADMINISTRATION	10.2	19.0	9.8	10.0	19.0	8.5
CONSUMER PRODUCT SAFETY COMMISSION	5.8	7.7	6.7	3.8	5.1	4.7
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION	2,937.7	4,344.3	4,988.7	2,588.8	3,637.9	4,396.4
ENVIRONMENTAL PROTECTION AGENCY	265.4	366.5	311.6	265.6	349.0	312.9
FEDERAL COMMUNICATIONS COMMISSION	1.5	2.1	2.1	1.1	2.2	2.0
FEDERAL ENERGY ADMINISTRATION	3.0	6.1	-	3.3	5.6	-
FEDERAL HOME LOAN BANK BOARD	.8	1.0	1.0	.8	1.0	1.0
FEDERAL TRADE COMMISSION	.9	1.1	1.2	.9	1.1	1.2
GENERAL SERVICES ADMINISTRATION	1.1	1.4	2.3	1.2	1.6	2.3
INTERSTATE COMMERCE COMMISSION	.1	.6	.4	.1	.6	.4
LIBRARY OF CONGRESS	3.0	3.1	3.4	2.9	3.2	3.3
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION	3,529.0	3,727.9	4,009.5	3,669.0	3,732.8	3,914.8
NATIONAL SCIENCE FOUNDATION	661.8	722.5	803.0	669.1	681.4	763.7
NUCLEAR REGULATORY COMMISSION	98.1	122.0	148.4	76.9	106.2	128.5
OFFICE OF TELECOMMUNICATIONS POLICY	4.6	3.5	3.9	4.7	3.5	3.9
SMALL BUSINESS ADMINISTRATION	.1	1.0	1.1	.1	1.0	1.1
SMITHSONIAN INSTITUTION	26.2	31.1	32.7	27.6	31.0	31.7
TENNESSEE VALLEY AUTHORITY	28.9	44.3	31.6	34.4	44.8	31.6
UNITED STATES ARMS CONTROL AND DISARMAMENT AGENCY	1.4	2.4	2.6	1.8	2.3	2.1
UNITED STATES INFORMATION AGENCY	.1	.1	.1	.1	.1	.1
UNITED STATES INTERNATIONAL TRADE COMMISSION	1.5	2.8	2.8	1.5	2.8	2.8
VETERANS ADMINISTRATION	109.5	117.2	117.7	109.5	117.2	117.7

* INDICATES AMOUNT LESS THAN $50,000.

SOURCE: NATIONAL SCIENCE FOUNDATION.

TABLE C-3. FEDERAL FUNDS FOR TOTAL RESEARCH AND DEVELOPMENT, BY AGENCY: FISCAL YEARS 1976, 1977, AND 1978

(MILLIONS OF DOLLARS)

AGENCY AND SUBDIVISION	OBLIGATIONS			OUTLAYS		
	ACTUAL,	ESTIMATES		ACTUAL,	ESTIMATES	
	1976	1977	1978	1976	1977	1978
TOTAL, ALL AGENCIES	20,758.6	24,465.3	26,316.7	19,892.9	22,278.2	24,623.6
DEPARTMENTS						
DEPARTMENT OF AGRICULTURE, TOTAL	462.4	525.3	573.8	460.0	535.4	569.5
AGRICULTURAL RESEARCH SERVICE	242.1	276.0	309.1	242.0	293.6	301.4
COOPERATIVE STATE RESEARCH SERVICE	113.4	128.7	136.4	104.2	131.5	139.4
ECONOMIC RESEARCH SERVICE	24.0	26.2	28.3	23.6	26.2	28.3
FARMER COOPERATIVE SERVICE	1.2	1.3	1.6	1.4	1.3	1.6
FOREST SERVICE	79.9	90.9	96.4	86.9	80.6	96.7
NATIONAL AGRICULTURAL LIBRARY	*	-	-	*	*	-
STATISTICAL REPORTING SERVICE	1.9	2.1	2.1	2.0	2.1	2.1
DEPARTMENT OF COMMERCE, TOTAL	228.9	247.4	239.5	225.5	243.9	252.7
BUREAU OF THE CENSUS	2.5	2.7	2.8	2.5	2.7	2.8
ECONOMIC DEVELOPMENT ADMINISTRATION	15.1	14.6	4.5	13.6	13.1	12.5
MARITIME ADMINISTRATION	19.0	17.9	16.4	22.8	16.8	21.3
NATIONAL BUREAU OF STANDARDS	47.4	53.9	50.3	48.0	54.2	50.8
NATIONAL FIRE PREVENTION AND CONTROL ADMINISTRATION	6.4	7.0	6.7	4.6	6.6	7.9
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	135.1	147.9	155.8	129.4	146.7	154.4
OFFICE OF MINORITY BUSINESS ENTERPRISE	2.0	2.0	1.6	3.2	1.8	1.6
OFFICE OF TELECOMMUNICATIONS	.9	1.0	1.0	1.1	1.7	1.0
PATENT AND TRADEMARK OFFICE	.4	.4	.4	.4	.4	.4
DEPARTMENT OF DEFENSE, TOTAL	9,654.7	11,171.8	12,108.1	8,954.1	9,931.8	10,983.6
DEPARTMENT OF THE ARMY	2,013.7	2,495.6	2,652.9	1,949.0	2,319.9	2,527.9
MILITARY FUNCTIONS	1,988.0	2,471.0	2,625.5	1,923.5	2,295.5	2,500.5
RDT&E APPROPRIATIONS	1,901.1	2,378.5	2,533.2	1,836.6	2,203.0	2,408.2
PAY AND ALLOWANCES OF MILITARY PERSONNEL IN R&D	86.9	92.5	92.3	86.9	92.5	92.3
CIVIL FUNCTIONS	25.7	24.6	27.4	25.4	24.4	27.4
DEPARTMENT OF THE NAVY	3,328.0	3,871.6	4,273.7	3,260.8	3,620.1	4,032.9
RDT&E APPROPRIATIONS	3,244.0	3,776.9	4,186.3	3,174.9	3,526.0	3,945.7
PAY AND ALLOWANCES OF MILITARY PERSONNEL IN R&D	81.1	91.1	84.2	81.1	91.1	84.2
SPECIAL FOREIGN CURRENCY PROGRAM	2.9	3.6	3.2	4.8	3.0	3.0
DEPARTMENT OF THE AIR FORCE	3,726.6	4,091.1	4,403.3	3,568.1	3,800.7	4,219.0
RDT&E APPROPRIATIONS	3,481.5	3,839.4	4,161.4	3,323.0	3,549.0	3,977.9
PAY AND ALLOWANCES OF MILITARY PERSONNEL IN R&D	245.1	251.7	241.9	245.1	251.7	241.9
DEFENSE AGENCIES	561.6	675.0	751.4	153.1	162.0	173.8
RDT&E APPROPRIATIONS	561.6	675.0	751.4	153.1	162.0	173.8
DEPARTMENTWIDE FUNDS	.7	.9	1.7	2.2	1.1	1.2
DIRECTOR OF TEST AND EVALUATION, DEFENSE	24.1	37.6	25.1	20.9	28.0	28.0
DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE, TOTAL	2,545.9	2,959.5	3,009.4	2,562.6	2,560.1	2,926.7
ALCOHOL, DRUG ABUSE AND MENTAL HEALTH ADMINISTRATION	139.5	155.0	155.2	145.1	140.6	151.6
CENTER FOR DISEASE CONTROL	49.6	60.4	59.5	37.1	77.9	62.5
FOOD AND DRUG ADMINISTRATION	37.1	42.8	47.4	18.5	37.0	41.8
HEALTH RESOURCES ADMINISTRATION	38.2	37.0	33.7	24.7	36.3	30.2
HEALTH SERVICES ADMINISTRATION	17.5	21.4	14.9	11.3	15.9	17.3
NATIONAL INSTITUTE OF EDUCATION	63.7	85.7	104.0	69.8	88.4	93.9
NATIONAL INSTITUTES OF HEALTH	2,022.6	2,233.9	2,295.1	2,066.5	1,933.3	2,243.7
OFFICE OF EDUCATION	58.2	174.7	150.0	56.8	76.7	132.8
OFFICE OF HUMAN DEVELOPMENT	61.9	78.1	72.1	61.4	83.2	77.2
OFFICE OF THE ASSISTANT SECRETARY FOR EDUCATION	1.0	1.0	1.0	1.5	1.7	1.6
OFFICE OF THE SECRETARY	23.7	20.0	22.4	32.5	22.0	22.5
SOCIAL AND REHABILITATION SERVICE	18.6	29.3	31.2	18.6	29.3	31.2
SOCIAL SECURITY ADMINISTRATION	14.4	20.1	22.8	18.9	17.8	20.2
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT	67.6	62.7	67.7	60.3	66.3	70.8
DEPARTMENT OF THE INTERIOR, TOTAL	314.2	348.4	361.5	333.2	342.2	365.3
BONNEVILLE POWER ADMINISTRATION	7.0	5.8	3.4	8.3	6.5	3.8
BUREAU OF LAND MANAGEMENT	.7	.9	1.4	.7	.9	1.4
BUREAU OF MINES	131.3	145.1	135.9	113.7	139.6	140.7
BUREAU OF OUTDOOR RECREATION	*	*	*	*	*	*
BUREAU OF RECLAMATION	8.3	10.3	9.0	8.7	11.4	9.0
GEOLOGICAL SURVEY	119.2	130.8	152.6	125.0	130.0	151.9
NATIONAL PARK SERVICE	9.3	9.9	11.8	9.3	9.9	11.8
OFFICE OF THE SECRETARY	1.0	4.9	2.4	.7	3.6	2.2
OFFICE OF WATER RESEARCH AND TECHNOLOGY	19.0	19.5	21.1	19.0	19.5	21.1
UNITED STATES FISH AND WILDLIFE SERVICE	18.4	21.1	23.9	17.8	20.7	23.4

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TABLE C-3. FEDERAL FUNDS FOR TOTAL RESEARCH AND DEVELOPMENT, BY AGENCY: FISCAL YEARS 1976, 1977, AND 1978

(MILLIONS OF DOLLARS)

- CONTINUED

AGENCY AND SUBDIVISION	OBLIGATIONS			OUTLAYS		
	ACTUAL, 1976	ESTIMATES		ACTUAL, 1976	ESTIMATES	
		1977	1978		1977	1978
DEPARTMENT OF JUSTICE, TOTAL	33.9	45.0	39.0	39.9	44.1	40.4
BUREAU OF PRISONS	.8	1.3	2.3	.7	1.2	1.6
DRUG ENFORCEMENT ADMINISTRATION	2.5	6.5	3.3	2.6	4.6	4.8
FEDERAL BUREAU OF INVESTIGATION	1.2	1.4	1.8	1.4	2.6	2.0
IMMIGRATION AND NATURALIZATION SERVICE	.1	.8	.4	-	.8	.4
LAW ENFORCEMENT ASSISTANCE ADMINISTRATION	29.2	35.0	29.5	35.2	35.0	29.5
OFFICE OF THE ATTORNEY GENERAL	-	-	2.0	-	-	2.0
DEPARTMENT OF LABOR, TOTAL	28.5	34.6	33.2	27.8	34.6	33.2
BUREAU OF LABOR STATISTICS	1.3	1.4	1.2	1.3	1.4	1.2
EMPLOYMENT AND TRAINING ADMINISTRATION	17.5	19.1	17.3	17.5	19.1	17.3
EMPLOYMENT STANDARDS ADMINISTRATION	4.3	5.5	5.6	4.1	5.5	5.6
LABOR-MANAGEMENT SERVICES ADMINISTRATION	.7	2.9	3.0	.7	2.9	3.0
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION	2.9	3.3	4.3	2.9	3.3	4.3
OFFICE OF THE SECRETARY	1.8	2.3	1.9	1.2	2.3	1.9
DEPARTMENT OF STATE, TOTAL	39.4	46.2	62.7	25.9	46.4	59.9
DEPARTMENTAL FUNDS	1.6	1.6	2.3	1.6	1.6	2.3
AGENCY FOR INTERNATIONAL DEVELOPMENT	37.8	44.6	60.3	24.3	44.8	57.6
DEPARTMENT OF TRANSPORTATION, TOTAL	294.5	407.4	398.4	323.6	377.0	374.7
FEDERAL AVIATION ADMINISTRATION	98.1	117.5	123.2	112.7	112.0	121.9
FEDERAL HIGHWAY ADMINISTRATION	28.9	54.4	54.4	42.5	48.5	54.3
FEDERAL RAILROAD ADMINISTRATION	50.4	61.7	44.2	40.5	49.7	36.1
MATERIALS TRANSPORTATION BUREAU	-	-	1.0	-	-	.6
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION	31.4	58.9	51.3	33.8	58.0	47.9
OFFICE OF THE SECRETARY	25.8	33.1	31.2	29.9	31.0	31.2
UNITED STATES COAST GUARD	12.4	22.3	22.0	17.3	21.5	20.3
URBAN MASS TRANSPORTATION ADMINISTRATION	47.5	59.5	71.1	46.9	56.3	62.4
DEPARTMENT OF THE TREASURY, TOTAL	3.7	5.3	6.8	3.7	5.8	6.7
BUREAU OF ALCOHOL, TOBACCO, AND FIREARMS	-	1.3	2.3	-	1.3	2.3
BUREAU OF ENGRAVING AND PRINTING	2.8	2.8	2.9	2.8	2.8	2.9
CUSTOMS SERVICE	1.0	1.2	1.6	1.0	1.7	1.4
OTHER AGENCIES						
ACTION	.1	.3	.3	.1	.3	.3
ADVISORY COMMISSION ON INTERGOVERNMENTAL RELATIONS	1.0	1.2	1.4	1.0	1.2	1.4
APPALACHIAN REGIONAL COMMISSION	.7	.8	.8	.7	.8	.8
CIVIL AERONAUTICS BOARD	.4	.5	.5	.4	.5	.5
CIVIL SERVICE COMMISSION	4.0	3.8	3.8	4.0	3.8	3.8
COMMUNITY SERVICES ADMINISTRATION	10.2	19.0	9.8	10.0	19.0	8.5
CONSUMER PRODUCT SAFETY COMMISSION	5.6	7.2	6.1	3.6	4.7	4.1
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION	2,498.9	3,609.8	4,143.0	2,224.6	3,167.9	3,797.5
ENVIRONMENTAL PROTECTION AGENCY	259.1	361.4	310.5	259.0	342.9	308.4
FEDERAL COMMUNICATIONS COMMISSION	1.5	2.1	2.1	1.1	2.2	2.0
FEDERAL ENERGY ADMINISTRATION	3.0	6.1	-	3.3	5.6	-
FEDERAL HOME LOAN BANK BOARD	.8	1.0	1.0	.8	1.0	1.0
FEDERAL TRADE COMMISSION	.9	1.1	1.2	.9	1.1	1.2
GENERAL SERVICES ADMINISTRATION	1.1	1.4	2.3	1.2	1.6	2.3
INTERSTATE COMMERCE COMMISSION	.1	.6	.4	.1	.6	.4
LIBRARY OF CONGRESS	3.0	3.1	3.4	2.9	3.2	3.3
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION	3,446.8	3,609.8	3,847.7	3,548.1	3,607.7	3,782.3
NATIONAL SCIENCE FOUNDATION	609.3	686.2	757.5	619.0	646.0	719.1
NUCLEAR REGULATORY COMMISSION	88.4	113.9	139.1	73.3	97.2	119.1
OFFICE OF TELECOMMUNICATIONS POLICY	4.6	3.5	3.9	4.7	3.5	3.9
SMALL BUSINESS ADMINISTRATION	.1	1.0	1.1	.1	1.0	1.1
SMITHSONIAN INSTITUTION	25.7	30.6	32.1	27.5	30.5	31.2
TENNESSEE VALLEY AUTHORITY	18.7	31.7	31.2	18.7	31.7	31.2
UNITED STATES ARMS CONTROL AND DISARMAMENT AGENCY	1.4	2.4	2.6	1.8	2.3	2.1
UNITED STATES INFORMATION AGENCY	.1	.1	.1	.1	.1	.1
UNITED STATES INTERNATIONAL TRADE COMMISSION	1.5	2.8	2.8	1.5	2.8	2.8
VETERANS ADMINISTRATION	97.7	110.4	111.8	97.7	110.4	111.8

* INDICATES AMOUNT LESS THAN $50,000.

SOURCE: NATIONAL SCIENCE FOUNDATION.

APPENDIX D

Statistical Tables
Part II

Federal Funds for Scientific and Technical Information

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NOTES

- Estimates for 1978 are based on *The Budget of the United States Government, Fiscal Year 1978*, as submitted to Congress, and do not reflect subsequent appropriations and apportionment actions.
- Obligations reported for extramural performance are limited to contracts or grants that have as their primary purpose the accomplishment of scientific or technical information functions. Obligations are excluded for information acctivities that supplement or support work under R&D contracts or grants.
- Obligations for research and development in information sciences, documentation and information systems, techniques and devices are also reported as part of R&D obligations in part I.
- Defense Agencies include the Defense Advanced Research Projects Agency, the Defense Nuclear Agency, the Defense Supply Agency, the Defense Communications Agency, and the Defense Logistics Agency.

Other Science Resources Publications

REPORTS	NSF NO.	PRICE
Federal Support to Universities, Colleges, and Selected Nonprofit Institutions, Fiscal Year 1975	77-311	$2.20
Detailed Statistical Tables. Fiscal Year 1976	77-325	—
Manpower Resources for Scientific Activities at Universities and Colleges, January 1976	77-308	$2.00
Detailed Statistical Tables. January 1977	77-321	—
Graduate Science Education: Student Support and Postdoctorals, Fall 1975	77-313	$2.20
Detailed Statistical Tables. Fall 1976	77-319	—
Expenditures for Scientific Activities at Universities and Colleges, Fiscal Year 1975	77-307	$2.00
Detailed Statistical Tables. Fiscal Year 1976	77-316	—
Characteristics of Doctoral Scientists and Engineers in the United States, 1975	77-309	$3.00
Women and Minorities in Science and Engineering	77-304	$0.75
U.S. Scientists and Engineers, 1974	76-329	$1.25
Characteristics of the National Sample of Scientists and Engineers, 1974		
Part 1. Demographic and Educational	75-333	$1.90
Part 2. Employment	76-323	$2.80
Part 3. Geographic	76-330	$2.00
1985 R&D Funding Projections	76-314	$2.10
Projections of Degrees and Enrollment in Science and Engineering Fields to 1985	76-301	$1.15
The 1972 Scientist and Engineer Population Redefined		
Volume 1. Demographic, Educational, and Professional Characteristics	75-313	$3.70
Volume 2. Labor Force and Employment Characteristics	75-327	$2.65
Detailed Statistical Tables. Engineers, By Field	76-306	—
R&D Activities of Independent Nonprofit Institutions, 1973	75-308	$1.90
Research and Development in State Government Agencies, Fiscal Years 1972 and 1973	75-303	$1.80
Young and Senior Science and Engineering Faculty, 1974: Support, Research Participation, and Tenure	75-302	$1.70
Projections of Science and Engineering Doctorate Supply and Utilization, 1980 and 1985	75-301	$1.30

REVIEWS OF DATA ON SCIENCE RESOURCES

No. 30.	"Scientific and Technical Personnel in Industry, 1960-70 and 1975"	78-302	$0.80
No. 29.	"Current and Future Utilization of Scientific and Technical Personnel in Energy-Related Activities"	77-315	$0.60
No. 28.	"Scientists and Engineers From Abroad. Trends of the Past Decade, 1966-75"	77-305	$0.35
No. 27.	"Education and Work Activities of Federal Scientific and Technical Personnel, January 1974"	76-308	$0.40
No. 23.	"R&D Expenditures of State Public Institutions, Fiscal Year 1973"	75-311	$0.35

HIGHLIGHTS

"Graduate Science Enrollment Stabilized in 1977"	78-307	—
"Utilization of Science and Engineering Doctorates in Industrial Research and Development	78-301	—
"Academic Employment of Full-time Scientists and Engineers Increases Another 3 Percent in 1977"	77-327	—
"National Sample of Scientists and Engineers: Changes in Employment, 1972-74 and 1974-76"	77-322	—
"Aptitude Test Scores of Prospective Graduate Students in Science Remained Essentially the Same From 1970 to 1975"	77-318	—
"Academic R&D Expenditures Up 9 Percent in FY 1976"	77-314	—
"Private Industry Employment of Scientists and Engineers in 1975 Shows 5-Year Decline"	77-312	—
"Graduate Science and Engineering Enrollment Up Only 1 Percent in 1976"	77-302	—